

## **Appendix G**

### **Closure and Post-Closure Plan**

## APPENDIX G – CLOSURE AND POST – CLOSURE PLAN

### **Closure and Post-Closure Plan**

Closure Plan Documentation (Part X.A. [Adopts by reference 40 CFR 270.14(b)(13)] of the GHWMRs)

#### **Introduction**

The purpose of this closure plan is to describe the procedures and methods by which the open burning/open detonation (OB/OD) units and surrounding area of the Andersen AFB Explosive Ordnance Disposal (EOD) Range will be closed in accordance with the Resource Conservation and Recovery Act (RCRA).

This plan describes the OB/OD units, decontamination and sampling procedures, health and safety requirements during closure, and the approximate closure schedule. This plan includes a Sampling and Analysis Plan (SAP) and a Quality Assurance Project Plan (QAPP) to be implemented at time of closure. (Attachment 1)

This closure plan is based on the achievement of clean closure of the facility. If clean closure cannot be achieved, this closure plan will be revised to include post-closure care requirements and restrictions. It will then be submitted to the appropriate regulatory agencies for review and approval.

#### **Location and Description of OB/OD Operations Facility**

The EOD Range has been operated exclusively for EOD purposes since the time (> 20 years) of its designation by Andersen Air Force Base. No operations other than OB/OD are conducted at the EOD Range. The mission of the range has been to render unserviceable ordnance and other pyrotechnic devices harmless by either suppressed detonation or open burning, as well as to allow EOD personnel to maintain a proficiency in the operation of explosive-actuated EOD tool sets. In addition, the range has been used for emergency purposes.

The EOD Range is located at the extreme eastern reach of Tarague Beach, just west of Tagua Point. The grid coordinates for the OD units are 13 degrees, 35.58 minutes north, 144 degrees, 56.48 minutes east. The active treatment units are provided with a 2,400-foot-radius safety zone, above and below the cliff line. The location of the treatment unit and the 2,400-foot-radius safety zone are delineated in Figure 2-12.

The active open detonation units are located at the extreme eastern edge of Tarague Beach. They consist of two pits, each located directly along the face of an approximately 30-foot tall cliff. Due to previous detonations, the cliff has been hollowed out slightly. Rocks which have been removed during previous detonations are piled on either side of the active OD units. Detonation of the munitions at the cliff face provides for additional safety with respect to directing the destructive force of the detonation away from occupied areas. Open detonations consist of placing the waste munitions in the OD pit, placing detonating charges (to initiate the detonation of the waste munition) and ignitors (to initiate the detonating charges). Detonation is remotely initiated from the personnel bunker.

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The inactive open burning pit was located directly on the beach in the sand in an area free of vegetation. It is approximately 80 feet north of the jungle (with a sharp rise), 150 to 190 feet south of the Pacific Ocean, and approximately centered east-west within the open range area.

The open burning units are operated in a different manner than the open detonation units. The open burning operations are characterized by: flammable dunnage (wood) is placed in the burn kettle for fuel and to provide air to the fire. Next, the waste munitions are placed in the burn kettle. These materials are then soaked with 10 - 15 gallons of fresh diesel fuel. An ignition device is placed in the burn kettle. The munitions are then remotely activated from the personnel bunker.

Open burning in the active OB unit was conducted in a burn kettle. This kettle was approximately 4 feet in diameter and 5 feet tall. The OB pit in which the burn kettle was placed was roughly 45 feet long by 14 feet wide by 6 feet deep.

Previous to 1992, the open burning operations at Andersen AFB EOD Range were not contained in a burn kettle, but were burned on the ground within the pit.

### **Applicability of Closure and Post-Closure Care Regulations**

1. All owners or operators of hazardous waste management facilities must prepare closure plans describing how each open burning and open detonation at the facility will be closed.
2. The hazardous waste management unit operated after November 18, 1980 (OB/OD units) at Andersen Air Force Base EOD Range is considered hazardous waste management units, since they treat reactive waste.
3. Therefore, the closure requirements under Part VII.A. [Adopts by reference 40CFR 264.110 – 264.120 (Subpart G)] of the GHWMRs are applicable to this facility.

Post-closure care regulations are applicable to Hazardous Waste Management Units that cannot be "clean closed" and must be closed in place. The post-closure care period for each unit that is closed in place must begin as soon as the unit is closed and must continue for 30 years (or other as specified in the permit).

It is the intention of this closure plan to achieve clean closure, thereby eliminating the requirement for post-closure care requirements.

### **Closure Requirements**

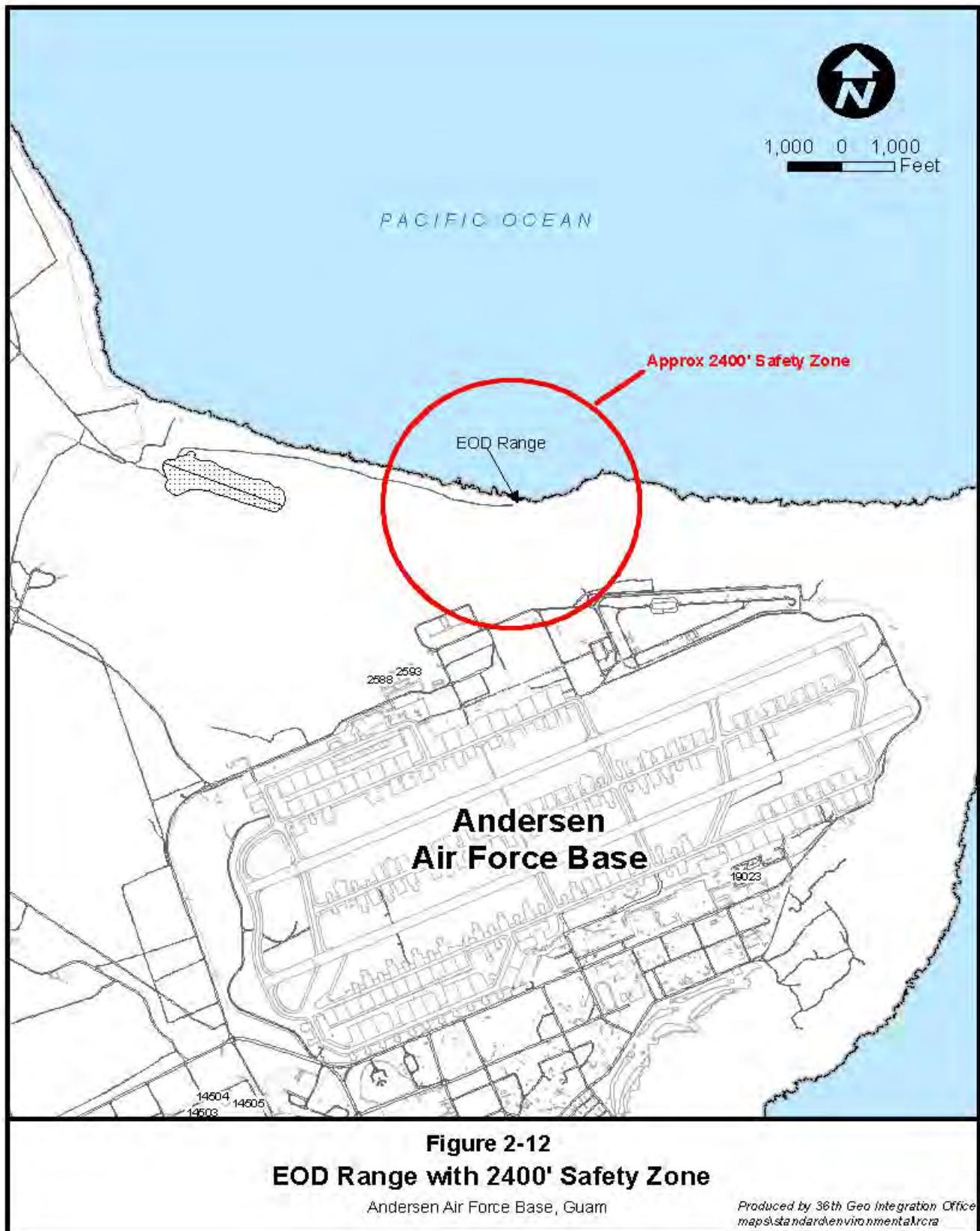
This plan describes the steps and techniques to completely close the Explosive Ordnance Disposal (EOD) Open Burning/Open Detonation (OB/OD) Range. This document has been prepared in accordance with Parts VI.A. and X.A. [Adopts by reference 40 CFR 264 Subpart X, Miscellaneous Units, 40 CFR 270.14(b)(13), and 40 CFR 264 Subpart G] of the GHWMRs requirements.

Andersen AFB Environmental Flight Office will maintain a copy of this closure plan, including all revisions, at least until certification of closure.

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### *Amendments to Closure Plan*

Any revisions to this closure plan will be submitted to the Guam Environmental Protection Agency (Guam EPA) for approval. The plan will be revised whenever any of the following would affect closure:



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- modifications are made to existing OB or OD structures;
- the quantity or composition of the waste material to be treated by OB/OD is increased or altered, operating procedures are revised, or regulatory requirements change;
- the expected year of closure changes;
- during closure activities, unexpected events occur that require a modification to the closure plan; and
- any closure plan procedures (e.g., decontamination or sampling) are revised to accommodate modern techniques.

*Closure Performance Standard (Part VI.A. [Adopts by reference 40 CFR 264.111(a), (b) and (c)] of the GHWMRs)*

The OB/OD units will be closed in such a manner as to meet the Closure Performance Standard. The proposed clean-closure will eliminate the need for further maintenance. The units will be closed to the extent necessary to protect human health and the environment through closure and post-closure. The closure procedures implemented herein will prevent the escape of hazardous waste, hazardous constituents, contaminated run-off, and waste decomposition products to the ground or surface waters or to the atmosphere. Part VI.A. [Adopts by reference 40 CFR 264.601 Subpart X] of the GHWMRs requires that miscellaneous units are closed in a manner that prevents any releases that may have adverse affects on human health and the environment due to migration of waste constituents in the groundwater, subsurface environment, surface water, wetlands, or on soil surface. Clean closure will assure that the closed OB/OD units will not affect human health or the environment.

Previous DOD studies of open burning units on the ground that had been operating a number of years have shown that contaminated soils and residues were present in the immediate vicinity of the OB unit; however, they were generally limited to the top 18 inches of soil (U.S. Army AEHA 1987). In addition, the soils were frequently not hazardous due to EP toxicity. Based on these studies and knowledge of the OB/OD units, it is anticipated that clean closure will be achieved for both the OB and OD units.

Closure will be achieved based on soil removal and decontamination as discussed in the following sections. These procedures will be utilized to achieve cleanup standards which are protective of human health and the environment, which are determined prior to closure. Several regulatory and health-based criteria will be considered, in conjunction with the planned use of the site, to determine cleanup levels. Health-based target concentrations (carcinogenic and non-carcinogenic effects) which have been developed in conjunction with this application will be considered for water and soil. These health based criteria may be revised at time of closure if risk assessment values or methods have been updated. Depending on the proposed groundwater usage, drinking water or other Maximum Contaminant Levels (MCLs) established under the Safe Drinking Water Act and Alternative Concentration Limits (ACLs) will be evaluated for groundwater concentrations. Background concentration limits for waste constituents in the soil will be evaluated as potential cleanup criteria, depending on plausible future patterns of use. The compounds of concern are those which will be sampled as per the closure sampling plan and baseline sampling plan. These compounds are listed in Table II-4, Standards, Criteria, and Benchmark Values of

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Sampling Parameters. The performance standard to eliminate air contamination is based on the termination of OB/OD activities.

### *Certification of Closure*

Certification that final closure of the units has been completed in accordance with the approved closure plan will be submitted to Guam EPA within 60 days of final closure. The certification will be sent by registered mail. The certification will be signed by the owner or operator (Andersen AFB Base Civil Engineer), the engineer responsible for oversight of the closure, and an independent professional engineer.

### *Description of Partial or Final Closure Procedures (Part VI.A. [Adopts by reference 40 CFR 264.112(b)(1) and (2)] of the GHWMRs)*

Andersen AFB intends to operate both the OB and OD units in tandem, until the units are no longer required. It is estimated that the OB/OD units will be operated until the Air Force Base ceases operation.

Therefore, the OB and OD units will be closed at the same time; no partial closure activities are contemplated.

The management of investigation and potential remediation of inactive SWMUs in the EOD Range are discussed in Section J, RCRA Corrective Action Section.

During final closure, each unit will be closed by treating the final volume of hazardous waste, treating the explosive residues generated during the last treatment, and removing of all metal from the surface of the beach for resale as scrap or disposal in accordance with applicable regulations.

The pit of each unit will then be sampled and analyzed in accordance with the OB/OD Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP) for Closure, Attachment 1. If any contaminated soil is identified, it will be removed and disposed of offsite. If it cannot be removed and disposed of, closure-in-place will be implemented following approval of a modified closure plan. After sampling and soil removal, the pits will be backfilled and re-graded. In addition to closure of the land pits, the burn kettle(s) will be decontaminated and recycled or disposed of in accordance with applicable regulations.

### *Description of Maximum Unclosed Portion During the Active Life of the Facility (Part VI.A. [Adopts by reference 40 CFR 264.112(b)(2)] of the GHWMRs)*

RCRA requires that the closure plan include a description identifying the maximum extent of the operations which will be unclosed during the active life of the facility.

During the active life of the EOD facility, the active OB/OD units will not be closed. The OD unit consists of two (2) pits, each located directly along the face of the cliff at the extreme eastern end of the beach. The active open burning treatment unit is located approximately 80 feet from the cliff and 150 to 190 feet from the ocean, approximately centered east-west within the range.

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**Table II-4**  
**Standards, Criteria and Benchmark Values for Sampling Parameters**

Chemical Name Listed in Composition and Combustion Lists	Human Health Criteria								
	RCRA Action Level			Health-Based Target Concentration					
				Non-carcinogenic Effects			Carcinogenic Effects		
	Air (mg/m <sup>3</sup> )	Water (µg/L)	Soil (mg/kg)	Air (mg/m <sup>3</sup> )	Water (µg/L)	Soil (mg/kg)	Air (mg/m <sup>3</sup> )	Water (µg/L)	Soil (mg/kg)
Barium	4.0E-01	2.0E+03	4.0E+03	5.90E-05	1.04E+00	5.20E+03			
Lead		1.5E+02		1.5E-03	2.23E-03	1.11E+01			
Silver			3.0E+02	2.9E-03	7.4E-02	3.71E+02			
Aluminum		2.0E+01	3.0E+01						
Copper				2.20E-02	5.48E-01	2.75E+03			
Iron									
Magnesium									
Strontium				3.56E-00	8.9E+00	4.46E+04			
Phosphorus									
Antimony		1.0E+03	3.0E+01	2.38E-04	5.94E-03	2.79E+01			
Calcium		1.0E+03	3.0E+03						
Potassium		2.0E+03	4.0E+03						
Tin				3.56E-01	8.91E+00	4.46E+04			
Sulfur									
Sulfates				6.77E+00	1.63E+02	7.20E+04			
Nitrates				9.50E-01	2.38E+01	1.19E+05			
Nitrites									
Ammonia				1.72E-02	1.44E+01	7.20E+04			
Cyanide									
1,3-Dinitrobenzene		4.00E+00	8.00E+00	5.94E-05	1.49E-03	7.43E+03			
2,4-Dinitrotoluene		5.0E-02		1.19E-04	2.97E-02	1.49E+02	9.64E-06	1.12E-04	9.01E-01
2,6-Dinitrotoluene		5.0E-02		5.94E-04	1.49E-02	7.43E+01	9.64E-06	1.12E-04	9.01E-01
Octahydro-1,3,5,7-tetranitro- 1,3,5,7-tetra (HMX)				2.97E-02	7.43E-01	3.70E+03			

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<b>Table II-4</b> <b>Standards, Criteria and Benchmark Values for Sampling Parameters</b>									
Chemical Name Listed in Composition and Combustion Lists	Human Health Criteria								
	RCRA Action Level			Health-Based Target Concentration					
				Non-carcinogenic Effects			Carcinogenic Effects		
	Air (mg/m <sup>3</sup> )	Water (µg/L)	Soil (mg/kg)	Air (mg/m <sup>3</sup> )	Water (µg/L)	Soil (mg/kg)	Air (mg/m <sup>3</sup> )	Water (µg/L)	Soil (mg/kg)
Nitroglycerin				2.97E-04	7.43E-03	3.71E+01	3.86E-04	4.50E-03	3.60E+01
Pentaerythritol tetranitrate (PETN)									
Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)				1.78E-03	4.46E-02	2.23E+02	5.96E-05	6.95E-04	3.75E+00
2,4,6-Trinitrotoluene (TNT)				2.97E-04	7.42E-03	3.71E+00	2.19E-04	2.55E-03	2.04E+01
Tetryl (Trinitrophenylmethyl nitramine)				5.94E-03	1.49E-01	7.43E+02			
Nitroguanidine				5.94E-02	1.49E+00				
Dibutyl phthalate		4.00E+03	8.00E+03	5.94E-02	1.49E+00				
Diphenylamine		9.00E+02	2.00E+03	1.49E-02	3.71E-01				
Hexachlorobenzene				4.75E-04	1.19E-02	4.10E-06	4.78E-05	3.38E-01	
TPH									
Hydrogen Cyanide				1.19E-02	2.97E-01				
Hydrogen Sulfide				1.54E-04	4.46E-02				
Nitrobenzene				3.56E-04	7.43E-03				
1,3,5-Trinitrobenzene				2.97E-05	7.43E-04				
White Phosphorus				1.19E-05	2.97E-04				

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*Estimate of Maximum Waste Inventory in Storage and Treatment During Facility Life (Part VI.A. [Adopts by reference 40 CFR 264.112(b)(3)] of the GHWMRs)*

The maximum inventory of hazardous wastes at the facility is based on the allowable range limitation on the net explosive weight (NEW) of unserviceable munitions.

The maximum amount of unserviceable munitions accommodated by the OB/OD units at one time is 600 pounds.

*Description of Procedures for Removal or Decontamination of Hazardous Waste Residues, Equipment, Structures, and Soils (Part VI.A [Adopts by reference 40 CFR 264.112(b)(4) and 264.114] of the GHWMRs) and Location of Disposal Facility*

The closure of the OB/OD units will be based on the most effective and practical treatment available at the time of closure. It will consist of removing and/or decontaminating all structures, soil and other materials contaminated with hazardous waste or hazardous constituents. The closure process will be phased to provide for most effective use of labor and equipment to accomplish the task. Critical decisions will be made throughout the process regarding subsequent steps, based on analysis conducted during closure to determine the extent of contamination and effectiveness of closure procedures.

### Closure Phase I -Materials Removal

The first phase of the closure activities will consist of identification and removal of metallic debris and unexploded ordnance materials. This closure phase will consist of several individual tasks:

1. Visual identification of the beach area surrounding the OB/OD units for metallic debris and unexploded ordnance (UXO) materials. This will consist of a complete "sweep" of the range for materials visible on the surface. Metallic materials will be collected and forwarded to the DRMO (Defense Reutilization and Marketing Office) for proper handling, storage, and recycling. UXO observed will be collected for final treatment by burning or detonation.
2. The beach sand in the range will then be mechanically raked to a depth of approximately 18 inches. Metallic debris and UXO materials observed during this raking will be similarly removed for disposal or treatment.
3. A sweep of the ocean floor between the shoreline and reef-line will be conducted of the area in front of (north) the EOD Range in a similar manner as the beach sweep.
4. A sweep of the jungle within a 300-foot-radius of the open detonation units will be conducted in a similar manner as the beach sweep.
5. In addition to the above noted sweeps, several lines will be traversed through the jungle beyond the 300-foot-radius to ensure there are no materials from the EOD operations. These traversed lines will continue out to the extent of the declared safety zone, 2,400 feet from the open detonation pits.

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### Closure Phase II - Equipment Decontamination

The second phase of the closure process includes removal of residues on the OB burn kettle, sampling, and decontamination phase, if required.

The material from the last treatment conducted in the burn kettle will be handled as per the accepted 36<sup>th</sup> Wing Instruction 32-3001 (36<sup>th</sup> WGI 32-3001). In summary, it will then be sampled to determine if it is hazardous waste or contains hazardous waste constituents. If the material is determined to be a hazardous waste, it will be disposed of at a permitted hazardous waste facility in accordance with regulatory requirements; otherwise, it will be disposed of in a permitted solid waste landfill to be determined.

Once the residues are removed, the burn kettle will be decontaminated. Two possible methods of decontamination of the burn kettle are described below. It is likely the final determination will be made at the time of closure.

1. Flashing. This method is accomplished by using the appropriate fuel and oxidizer to cause the temperature of the containment device to exceed the auto ignition or decomposition temperature of the PEP wastes that have been burned in the unit. The process is utilized by explosives handlers to decontaminate equipment used to haul or store explosive materials (U.S. Army AEHA 1987).
2. Washing. This method consists of decontaminating the burn kettle by first washing with a detergent followed by steam cleaning. After decontamination, any waste waters generated will be placed in appropriate sized drums and sampled for the parameters listed in the OB/OD SAP/QAPP for Closure, Attachment 1. The liquid wastes will then be disposed of in accordance with regulatory requirements.

Once the burn kettle is decontaminated, it will be sampled with surface wipe testing to assure that the decontamination was effective. The wipe sample(s) will be analyzed for the parameters listed in Section 5 and Table 5-1 (Sample ID# OBCD), of the OB/OD SAP/QAPP for Closure, Attachment 1.

*Location of Disposal Facility.* Once confirmatory sampling is completed, the burn kettle will be processed through the DRMO for recycling as scrap steel. Disposal of contaminated soils (if required) will also be processed through the DRMO facility.

### Closure Phase III - Soil/Groundwater Investigation

The third phase of the closure will consist of implementation of the sampling plan to determine the extent of contamination of hazardous wastes or hazardous constituents at the OB/OD range.

Prior to sampling, the range will be evaluated as to whether unexploded ordnance (UXO) remains on site below the depths reached in the beach raking operation. An electromagnetic surveyor ground penetrating radar will be implemented to detect the presence of metal. The ocean will be surveyed by one of these methods for metallic UXO materials from the beach to the reef line, in the vicinity of the OB/OD units. The beach and jungle immediately surrounding the OB/OD units will also be surveyed by one of these methods for metallic UXO materials (300 foot radius).

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If buried UXO is detected in or around the OD unit, the unit will be evaluated by a remote drilling operation. It is unlikely that UXO will be found in the EOD Range. However, if it is located, it will be treated in-place or in the OB/OD unit(s).

*Methods for Sampling and Testing Surrounding Soils.* Sampling activities will commence once the UXO survey is completed. Representative soil samples will be taken from locations throughout the OB/OD range. Sampling and analysis will conform to the procedures summarized in the OB/OD SAP/QAPP for Closure, Attachment 1.

Once samples have been analyzed, a decision will be made regarding the next step of closure. If soil samples have been determined to be contaminated with hazardous wastes or hazardous constituents, secondary sampling may be conducted to determine more precisely the extent of soil that should be removed.

*Criteria for Determining Decontamination Levels.* The criteria for determining the extent of decontamination required to satisfy the closure performance standards will be developed prior to closure. The units will be closed to the extent necessary to protect human health and the environment by implementation of a clean-closure. The cleanup levels will be based on regulatory and health-based criteria in conjunction with the planned use of the site. Potential future uses of the site include archaeological and/or wildlife preservation areas.

Health-based target concentrations (carcinogenic and non-carcinogenic effects) which have been developed in conjunction with this application will be considered for water and soil. These health-based criteria may be revised at time of closure if risk assessment values or methods have been updated. If the groundwater may be used for drinking water in the future, MCLs established under the Safe Drinking Water Act will be applied to groundwater. However, ACLs will be evaluated for groundwater concentrations if there are no future plans for drinking water (see Table II-4, Standards Criteria, and Benchmark Values for Sampling Parameters). Background concentration limits for waste constituents in the soil will be evaluated as potential cleanup criteria, depending on plausible future patterns of use. The compounds of concern are those which will be sampled as per the closure sampling plan and baseline sampling plan. These compounds are listed in Table 5-2.

### Closure Phase IV –Soil/Groundwater Closure

The fourth phase will consist of soil removal and confirmatory sampling, if required to achieve clean closure. If excavation is required, it is probable that a request for extension of closure will be submitted for approval. The final decision as to treatment method(s) will be determined at the time of closure. If any soil is determined to be hazardous, remediation will be implemented. All contaminated soil will be excavated, placed in drums, and disposed of in accordance with applicable regulations at a permitted facility to be determined. Excavation would be completed to the extent possible and/or practical. If it were determined that it was not feasible to excavate soil and a closure-in-place would be required, an amendment to the closure plan would be submitted to Guam EPA for approval. However, it is the intent of this closure plan to achieve clean closure and this requirement for closure in-place is considered highly unlikely.

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If buried UXO cannot be removed or disposed of safely, it will remain in place. In this unlikely event, the facility will be considered closed-in-place, and an amendment to the closure plan will be submitted for review and approval to the appropriate regulatory agencies. If buried UXO is not removed, a deed restriction will be placed on the property (refer to the Documentation of Notice of Deed of this section). Clean sand or soil will be brought to the treatment units for clean fill. The beach area will then be re-graded.

### *Personnel and Human Health Protection During Closure Activities*

The closure of the OB/OD units will be implemented in a manner that is safe to all involved personnel and to human health and the environment. The Contingency Plan and the Preparedness and Prevention Plan as included in the RCRA Part B Subpart X Permit for the EOD Range will be implemented as appropriate to closure operations. All contractors involved with closure activities will be required to be familiar with these plans.

In addition, a Health and Safety Plan (HASP) will be developed and implemented to address the potential hazards associated with this closure. It is probable that the most likely potential hazard(s) is unexploded energetic material and other physical/equipment hazards. The potential for chemical hazards is low.

Andersen AFB EOD personnel or other trained EOD specialists will conduct or will oversee all closure activities that involve reactive materials or UXO. All personnel involved with closure will have the appropriate training in hazardous waste operations.

EOD security and inspection procedures will continue throughout the closure period through closure certification. In addition, EOD personnel or contractors performing closure tasks will inspect temporary storage areas.

### *Hazardous Waste and Materials*

A temporary storage area will be set up on the EOD Range to store closure equipment and wastes generated during closure prior to disposal. Any material determined to be reactive or UXO will be treated onsite in the OB/OD units in accordance with the standard FOI (SOP) and will not be stored in the temporary storage area.

All wastes will be properly labeled. If any wastes are determined to be hazardous, they will be marked with "Hazardous Waste" labels, the EPA ID number of Andersen AFB, the date of generation, and other items required by RCRA regulations and additional Guam EPA requirements, if any. Wastes which may be stored in the temporary storage area include the following:

- burn kettle waste
- contaminated soils and debris contaminated liquids (generated from decontamination procedures)
- miscellaneous wastes (paper, wood, metal, etc.) collected from the EOD Range or generated (during closure activities)

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*Description of Additional Activities Performed During Closure (Part VI.A. [Adopts by reference 40 CFR 264.112(b)(5)] of the GHWMRs)*

*Groundwater monitoring.* For discussion of groundwater monitoring, refer in this section to Description of Procedures for Removal or Decontamination of Hazardous Waste Residues, Equipment, Structures and Soils, Soil and Groundwater Investigation and Closure Sampling Plan.

*Leachate collection.* Leachate collection will not be applicable since the unit will undergo clean closure.

*Run-on and run-off control.* Run-on and run-off may be utilized during closure activities such as covering of drums of decontamination wastes. Run-on and run-off control will not be required during post-closure, since clean closure will be achieved.

*Description of Closure Schedule (Part VI.A. [Adopts by reference 40 CFR 264.112(b)(6) and 264.113] of the GHWMRs)*

The federal regulations require that the owner or operator must treat, remove from the unit or facility, or dispose of on-site, all hazardous wastes in accordance with the approved closure plan within 90 days after receiving the final volume of hazardous wastes. In the case of the EOD operations, when munitions are determined to be unserviceable, they are declared to be hazardous waste. As long as there are munitions at Andersen AFB, the potential exists for the generation of hazardous waste. Therefore, for purposes of this application, the 90-day clock will not commence until all munitions, which may eventually be declared unserviceable and may be treated by EOD operations, are removed or treated by the EOD units. The exception to this statement is if a new process is designed which may treat the unserviceable munitions at Andersen AFB more effectively or in a more environmentally feasible process.

On the day final volume of hazardous wastes is received, the EOD Range will treat the final volume of hazardous wastes and any hazardous residues which may remain in the burn kettle.

The regulations require that the owner or operator complete final closure activities in accordance with the approved closure plan within 180 days after receiving the final volume of hazardous wastes. It is anticipated that the EOD Range will undergo clean closure within the 180-day period without the need of an extension.

See Table II-5, Timetable of Closure Activities.

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Table II-5  
Timetable of Closure Activities

Task	Days from Initiation of Closure
<b><u>Phase 1</u></b>	
Notify Guam EPA of intent to close facility	0 -30
Receive final volume of hazardous waste	0
Treat final volume of hazardous waste	0
Remove residues from final volume of waste treated	1
Initiate closure	1
Rake EOD Range for UXO's and Metals	2 to 45
Treat any UXO that is recovered from raking	10 to 55
Recover and remove all metal	1 to 45
If more time is required for closure, request extension	60 to 150
<b><u>Phase 2</u></b>	
Decontaminate, sample and dispose of burn kettle	55 to 90
<b><u>Phase 3</u></b>	
Sample and analyze soil surrounding units in accordance with sampling plan and QAPP	90 to 120
<b><u>Phase 4</u></b>	
Remove contaminated soil if required	120 to 160
Confirmatory sampling of units if required	120 to 160
Fill re-grade treatment units	160 to 179
Complete clean closure	180
Submit closure certification to Guam EPA	180 to 240

Note: Minor variances from this timetable may be made as required to accommodate closure requirements. These variances will comply with regulatory requirements.

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The closure of the EOD Range will take place in accordance with the time line provided in Table II-5, Timetable of Closure Activities.

### *Estimate of Year of Closure (Part VI.A. [Adopts by reference 40 CFR 264.112(b)(7)] of the GHWMRs)*

The estimate of the year of closure is not predictable at this time. It is assumed that the EOD Range will be required to operate as long as ordnance are maintained at Andersen AFB. It is expected that ordnance will be maintained until the base is closed. The decision to close Andersen AFB will ultimately be made through governmental process and will not be the responsibility of the EOD Commander or the Andersen AFB Commander.

For purposes of this permit, however, the estimate year of closure is 2043, or 50 years from the date of this application.

### *Extension of Closure Time (Part VI.A. [Adopts by reference 40 CFR 264.113(a) and (b)] of the GHWMRs)*

Final closure will be completed within 180 days after receiving the final volume of hazardous wastes. If it is determined that final closure activities will, of necessity, take longer than 180 days to complete; it is determined that closure of the unit(s) is incompatible with continued operation of Andersen AFB; or if there is reasonable likelihood that another person will recommence operation within 1 year, then a modification to the closure plan permit will be requested. The request for modification will be submitted to Guam EPA at least 30 days prior to the end of the 180-day period (after receiving final volume of hazardous waste).

The request will demonstrate the reason(s) for requesting an extension. In addition, the request will demonstrate that the range will continue to be operated in compliance with all applicable permit requirements and that all steps to prevent threats to human health and the environment will be taken.

### **Copy of Post-Closure Plan (Part VI.A. [Adopts by reference 40 CFR 264.117, 264.118, and 264.603] of the GHWMRs)**

The purpose of the closure plan is to achieve clean closure; therefore, post-closure requirements will not be applicable to the OB/OD units on the EOD Range. The determination that clean closure can be achieved is based on the type of operation utilized and scientific judgment. Clean closure is the preferred option, since it will result in the lowest level risk to human health and the environment. If, in the unlikely event it is determined that the quantity of soil required to be removed to achieve clean closure is not practical then a closure-in-place will be implemented. In this case the closure plan will be amended and submitted to Guam EPA for review and approval.

The following paragraphs discuss the applicability of post-closure requirements based on the achievement of clean closure.

## APPENDIX G – CLOSURE AND POST – CLOSURE PLAN

### *Post-Closure Care Mechanisms (Part VI.A. [Adopts by reference 40 CFR 264.603] of the GHWMRs)*

A miscellaneous unit that is a disposal unit must be maintained in a manner during the post-closure period that prevents any releases that may have adverse affects on human health and the environment due to migration of waste constituents in the groundwater, subsurface environment, surface water, wetlands, or on soil surface. Clean closure will assure that the closed OB/OD units will not affect human health or the environment.

In the event that clean closure is not achieved, the closure plan will be amended to include criteria to assure that any waste constituents remaining at closure will not cause adverse effects to human health or the environment.

### *Description of Maintenance, Monitoring, Inspection, and Frequencies Required to Comply with Applicable Regulatory Requirements (Part VI.A. [Adopts by reference 40 CFR 264.118(b)(1) and (2)] of the GHWMRs)*

Based on clean-closure, the units will not require post-closure monitoring of groundwater, air or soil. Since there will be no structural requirements for clean closure (such as a cap), there will be no post-closure maintenance or inspection requirements.

In the event that clean closure is not achieved, the closure plan will be amended to include post-closure monitoring, maintenance, and inspection plan.

### *Identification and Location of Person Responsible for Storage and for Updating Facility Copy of Post-Closure Plan During Post-Closure Period (Part VI.A. [Adopts by reference 40 CFR 264.118(b)(3)] of the GHWMRs)*

Based on clean-closure, a post-closure plan is not required for this application; therefore, this is not an applicable requirement.

In the event that post-closure is required an employee in CES/CEV or EOD will be designated to store and update copies of the post-closure plan. The post-closure plan will be maintained for at least 30 years after certification of closure.

### *Procedure for Updating All Other Copies of Post-Closure Plan (Part VI.A. [Adopts by reference 40 CFR 264.118(b)(2)] of the GHWMRs)*

Based on clean-closure, a procedure for updating all other copies of the post-closure plan is not required. In the event that post-closure is required a procedure for updating all other copies of the post-closure plan will be implemented in the amendment submitted to Guam EPA. An employee in CES/CEV or EOD will be designated to update all other copies of the post-closure plan.

### *Survey Plat*

Based on clean-closure, a survey plat is not required.

## APPENDIX G – CLOSURE AND POST – CLOSURE PLAN

In the event that post-closure is required, a survey plat will be submitted to the local zoning authority. The plat will be certified by a registered professional engineer and will meet all designated regulatory requirements.

### *Post-Closure Certification*

Based on clean-closure, a post-closure certification is not required.

In the event that post-closure is required, a certification of post-closure will be submitted to Guam EPA, 60 days prior to the end of the post-closure care period (30 years from closure certification).

### *Submittal of Post-Closure Record of Hazardous Waste*

Based on clean-closure, hazardous waste will not remain at the facility after closure. Therefore, a record of hazardous waste will not be required to be submitted to the local zoning authority, or authority with jurisdiction over local land use, and Guam EPA.

If clean-closure is not achieved, a record of the type, location and quantity of hazardous wastes remaining within each unit will be submitted to the above mentioned agency within 60 days after certification of closure.

### **Copy of Most Recent Closure and Post-Closure Cost Estimates (Parts VI.A and X.A. [Adopts by reference 40 CFR 264.142, 264.144, and 270.14(b)(15) and (16)] of the GHWMRs)**

Since U.S. Government installations are exempt from these requirements, they are not addressed in this application.

### **Copy of Documents Used as Financial Assurance Mechanisms (Part VI.A. [Adopts by reference 40 CFR 264.143, 264.145, and 264.146] of the HWMRs)**

Since U.S. Government installations are exempt from these requirements, they are not addressed in this application.

### **Documentation of Notice of Deed (Parts VI.A and X.A. [Adopts by reference 264.11940 and CFR 270.14(b)(14)] of the GHWMRs)**

Since this closure plan is based on clean closure, post-closure notices, including a notice of deed restriction, will not be required.

If clean closure, is not achieved (contaminated soil is not removed or UXO is left in place) or if it is determined at the time of closure that a potential for UXO exists at the EOD Range, then the Air Force will record a notation on the deed to the facility property. Alternatively, a notation may be placed on some other instrument, such as a restrictive covenant or easement, which is normally examined during title search. This notation will state that hazardous wastes have been disposed on the property and that property use is restricted under 40 CFR Subpart G regulations. The deed notice will also indicate that a survey plat and record of waste have been filed.

## APPENDIX G – CLOSURE AND POST – CLOSURE PLAN

If required, the deed notation will be recorded within 60 days of certification of closure of the first and last hazardous waste disposal unit. Following the notation to the deed, the Air Force will sign a certification, stating that the deed notification has been recorded. This certification will be sent to the Administrator of Guam EPA, and it will include a copy of the document in which the notification has been placed.

### **Copy of Insurance Policy (Part VI.A. [Adopts by reference 40 CFR 264.147] of the GHWMRs)**

Since U.S. Government installations are exempt from these requirements, they are not addressed in this application.

### **Closure Sampling Plan**

#### Introduction

The closure sampling plan for clean-closure of the Andersen AFB EOD OB/OD units will be implemented in accordance with 40 CFR 264 Subpart G requirements. The sampling activities that will be performed at the time of closure of the OB/OD units will be reevaluated based on the results of the initial baseline sampling program and continued sampling program for detection monitoring. Closure sampling will be conducted before, during and after site remediation activities.

#### *Pre-Closure Soil Quality Sampling*

Shallow soil sampling will be performed on a sampling grid established during the baseline sampling program. Soil sample site grid concentrations will be greater in the immediate vicinity of the OD pit and the burn pit. A limited number of soil samples will be collected along traverse lines extending from the OD pit and burn pit extending to the ocean and the edge of the safety zone.

A geophysical survey of the OD pit, burn pit, and adjacent areas will be conducted prior to soil sampling to detect buried metallic objects which may be indicative of live ordnance. Reconnaissance surveying will be performed using electromagnetic induction (EM-31 and EM-34). Electrical anomalies defined with the EM techniques will be followed with high-resolution profiling using ground penetrating radar (GPR) (as required). Geophysical anomalies that would indicate the potential presence of live ordnance would be brought to the attention of EOD experts. Soil sample locations will be positioned to void any potential safety hazards identified with these geophysical tools.

Pre-closure shallow soil sampling will be divided into two separate sampling schemes. The first scheme will define the vertical and lateral extent of soil contamination within the areas of greatest potential contamination, the OB and OD pits and their immediate vicinity. The second sampling scheme will be conducted outside the immediate vicinity of the active units to determine if significant contamination has resulted from ordnance and related materials ejected during OD unit operations.

The soil sample collection scheme and methodology are discussed in the OB/OD SAP/QAPP for Closure. (Attachment 1)

## APPENDIX G – CLOSURE AND POST – CLOSURE PLAN

### *Soil Closure Sampling*

After the removal of contaminated soil, a round of clearance samples will be collected to determine the effectiveness of the remediation. The clearance samples will be collected from a depth interval below the contaminated soil excavation. Approximately 15 clearance samples will be collected from randomly selected grid cells from the OB and OD pits and their immediate vicinity. Upon evaluation of the clearance sample analytical results, additional soil excavation and sampling may be warranted.

### *Groundwater Sampling*

Groundwater sampling during closure activities will be based upon the OB/OD SAP/QAPP for Closure. (Attachment 1) During the active operation of the OB/OD units, a groundwater monitoring program will be implemented based on 40 CFR 264 Subpart F, Releases from Solid Waste Management Units. The first phase of proposed monitoring will consist of baseline monitoring event. The parameters for this event are listed in Table 5-2 of the OB/OD Sampling and Analysis Plan/Quality Assurance Project Plan for Closure. Based on the initial sampling, a detection monitoring program may be developed to determine whether hazardous constituents are detected at the active facility. If detection monitoring is continued throughout the active life of the facility, the closure sampling will consist of the final round of detection groundwater monitoring. The quality of the groundwater at the EOD range will be well defined prior to closure, in this case.

If the analytical results of the monitoring program indicate that groundwater remediation is warranted, an appropriate groundwater remedial plan will be developed. Prior to clean closure, a final round of groundwater samples will be collected for laboratory analysis.

### *Monitoring Well Closure*

Following review of the final round of groundwater monitoring analytical results the monitoring wells will be closed in an environmentally appropriate manner. Well closure will include removal of casing and over-drilling and plugging with a non-shrinking grout.

### **Quality Assurance Project Plan**

All samples taken for analysis will be analyzed in accordance with Quality Assurance Project Plan requirements, Section 6, Attachment 1 of Appendix G.

# **Attachment 1**

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OB/OD Sampling and Analysis Plan / Quality Assurance  
Project Plan for Closure

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## List of Abbreviations and Acronyms

AAFB	Andersen Air Force Base
BTEX	benzene, toluene, ethyl benzene, and xylenes
EOD	explosive ordnance disposal
ft	foot
ft-msl	feet above mean sea level
GCMS	gas chromatography-mass spectrometry
GPS	global positioning system
HASP	Health and Safety Plan
HMX	1,3,5,7-tetrazocine, octahydro-1,3,5,7-tetranitro
HWMF	Hazardous Waste Management Facility
ICP	inductively coupled plasma
ICPMS	inductively coupled plasma-mass spectrometry
IRP	Installation Restoration Program
MS/MSD	matrix spike/matrix spike duplicate
OB/OD	open burning/open detonation
PCBs	polychlorinated biphenyls
PETN	pentaerythritol tetranitrate
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act
RDX	cyclotrimethylene trinitramine
SVOA	semivolatile organic analysis
TIC	tentatively identified compound
TKN	total Kjeldahl nitrogen
USATHAMA	United States Army Toxic and Hazardous Materials Agency
USEPA	United States Environmental Protection Agency
VOA	Volatile Organic Analysis

## **Section 1: Introduction**

This Sampling and Analysis Plan for Closure of the Open Burning/Open Detonation (OB/OD) Facility at Andersen Air Force Base is based on clean closure. As part of the closure process, sampling will be performed to evaluate the extent of site contamination (if any) and to determine the effectiveness of remedial activities. Additional sampling and analysis will be required to characterize closure-generated waste and investigation-derived waste in order to determine appropriate disposal procedures.

This plan presents the sampling and analysis activities that will be performed at the time of closure of the OB/OD units and supplements information provided in Appendix G. A brief description of the EOD site is presented in Section 2, the sampling program is presented in Section 3, sampling procedures in Section 4, analytical scope in Section 5, and quality assurance procedures presented in Section 6. Certain elements of this plan refer to other sampling programs that may have not yet been implemented, specifically the baseline sampling program and the groundwater monitoring plan.

In addition, this closure sampling and analysis plan was compiled using current practices and practically available technology circa mid 1990's. This closure plan is intended, to be implemented at the time of closure of the EOD Range facility. The time of closure was stated in the 1993 RCRA Part B application to be approximately 50 years hence. It is reasonable to presume this proposed plan will be reevaluated prior to implementation to confirm its appropriateness.

## **Section 2: Site Description**

AAFB is currently the home of the Pacific Air Forces' 36<sup>th</sup> Wing. The AAFB EOD Range has been operated solely for EOD purposes since the time of its designation more than 20 years ago. The primary mission of the EOD Range has been to render harmless those ordnance and other pyrotechnic devices that are unserviceable. In addition, the range has been used for EOD training and emergency purposes.

### ***2.1 Location***

AAFB is at the northern end of the island of Guam. The island is 30 miles long and ranges from 4 to 12 miles wide (see Figure 2-1). AAFB is approximately 8 miles east to west and varies from 2 to 4 miles north to south.

The EOD Range is at the extreme eastern reach of Tarague Beach, ending just before Tagua Point (Figure 2-2). The EOD Range is defined as the open beach area at the east end of Tarague Beach, bounded by the Pacific Ocean to the north and the jungle and/or limestone cliff line to the east, south, and west. A 2,400-foot (ft)-radius safety zone, defined by operational requirements, surrounds the detonation treatment unit.

The EOD range is in a restricted area within AAFB, north of the active runways. The area within at least 1,000 feet (ft) of the EOD range is restricted military land, including fringing reef and reef flat, beach, old coconut plantations, and limestone forest (jungle).

### ***2.2 Meteorology***

The dominant winds on Guam are the trade winds, which blow onto the island from the east or northeast. The wind rose for AAFB is presented in Figure 2-3, based on data collected at the main runway during the

period of 1987-1991. Winds at the EOD Range are expected to be similar to those observed at the AAFB meteorological station, primarily from the east and northeast

Annual rainfall at AAFB averages approximately 92 inches. Most of this precipitation occurs during the wet season, from July through mid-November. Monthly average rainfall ranges from approximately 4 inches in April to approximately 14 inches in August. Some precipitation occur an average of 246 days per year. Rainfall at the EOD range is expected to be consistent with the average amounts measured at the AAFB meteorological station.

Temperatures at AAFB are uniformly warm, and relative humidity is high throughout the year. Average daily maximum temperatures range from 82°F to 86°F and average daily minimum temperatures range from 71°F to 73°F. Relative humidity typically ranges from 70 to 80 percent during the day and from 85 to 95 percent during the night.

### **2.3     *Topography***

The EOD Range facility has an elevation ranging from sea level at the northern end to approximately 40 feet above mean sea level (ft-msl) to the south. The EOD Range facility restricted area is surrounded by uninhabited limestone forest (jungle) to the south (including a cliff approximately 450 feet high), east, and west and the Pacific Ocean to the north. Within the EOD range topographic features include a gently sloping sand beach (0-25' MSL) and a 25 feet tall cliff in the immediate vicinity of the OD treatment unit.

### **2.4     *Geology***

Bedrock geology at the EOD Range consists of Pliocene/Pleistocene Age Mariana Limestone overlain by recent beach deposits of calcareous sand. The Mariana Limestone consists of two members: the main body of the unit and the Agana argillaceous member. The main body is then made up of four (4) mappable reef-associated facies.

The detrital facies of the Mariana Limestone underlies the entire EOD Range, extending from the near shore reef line to the north to the cliff crest to the south. The detrital facies consists of fine-to coarse grained detrital limestone representing a lagoonal depositional environment. Field observation confirmed that this limestone is porous and cavernous in places and contains scattered to abundant fossilized coral heads. The presumption is made that this facies underlies the local beach deposits.

Laterally, the dermal facies extends eastward around Pati Point and thins westward to Ritidian Point. Within the westward thinning, this facies has inclusions of the Mariana Limestone reef facies and Miocene Age Barrigada Limestone.

Bedrock outcrops were observed throughout the EOD range. Outcropping was abundant within the intertidal zone, along the terrace and cliff base, and within the jungle, due to poor soil development.

### **2.5     *Hydrogeology***

Available Installation Restoration Program (IRP) documents indicate that a test boring in the area of the EOD Range encountered a surficial aquifer at a depth of approximately 21 feet below grade. The test boring was installed on October 9, 1992, at a location approximately 120 feet west of the OB unit. Considering tidal fluctuations, the reported depth to water approximates sea level, as would be expected. No additional groundwater data have been collected to date.

Although specific local groundwater data are unavailable, the groundwater gradient at the EOD Range is presumed to be north towards the Pacific Ocean. This presumption is made based on the field verification of groundwater discharges to the Pacific Ocean. Preliminary data from the IRP investigation indicate the overall large-scale (across the whole base) gradient is flat.

## **2.6     *Surface Water***

Perennial streams do not exist on the northern half of the island because this area is underlain by highly permeable limestone and beach sands. During heavy rainfall, the surface water runoff may flow in short channels in the limestone but eventually disappears into the numerous sinkholes and fissures.

The EOD Range facility is bounded on the north by the Pacific Ocean. Portions of the range are within the 100 year flood plain zone because of susceptibility to flooding during typhoons or from tidal waves.



Figure 2-1

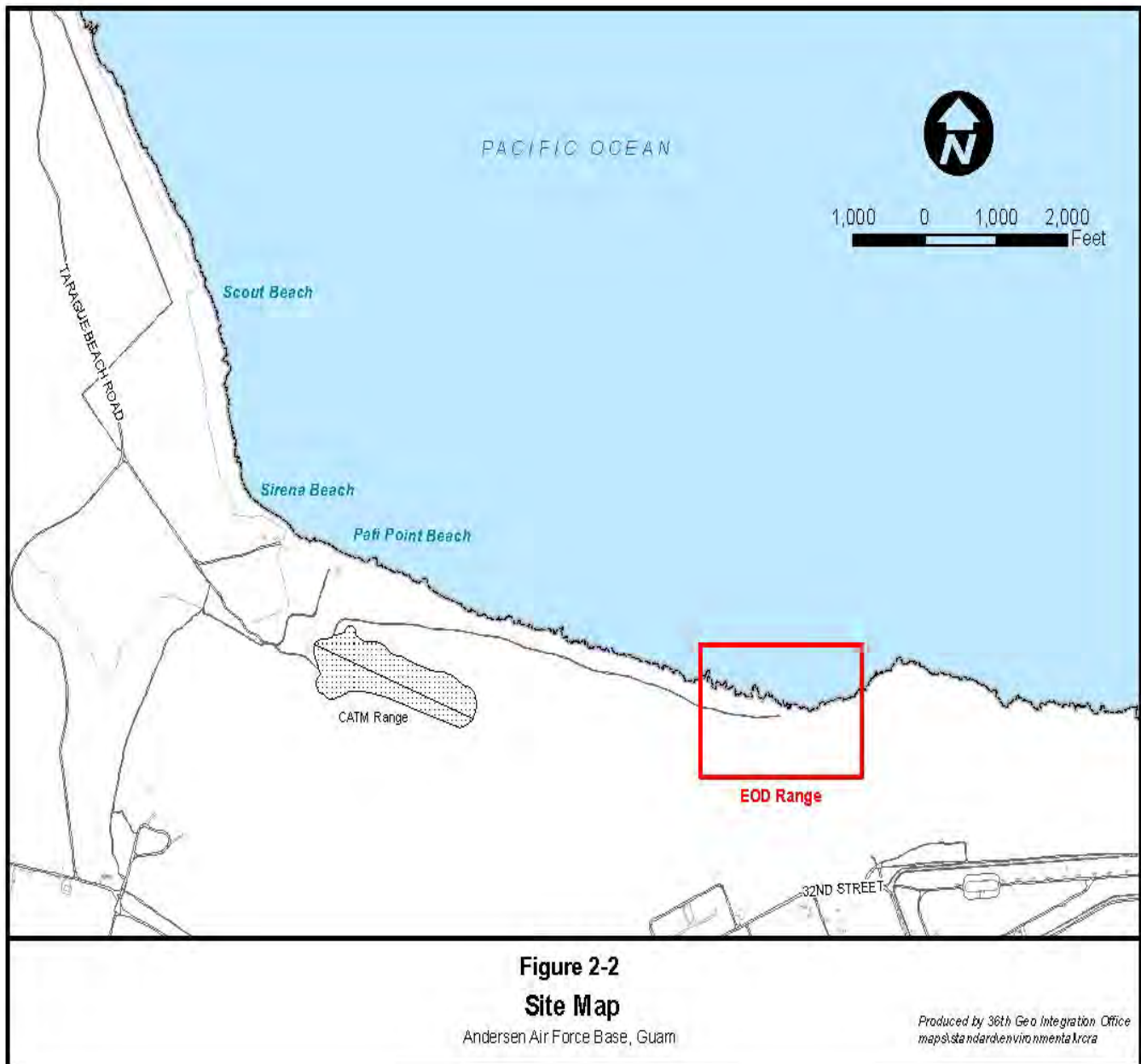


Figure 2-2

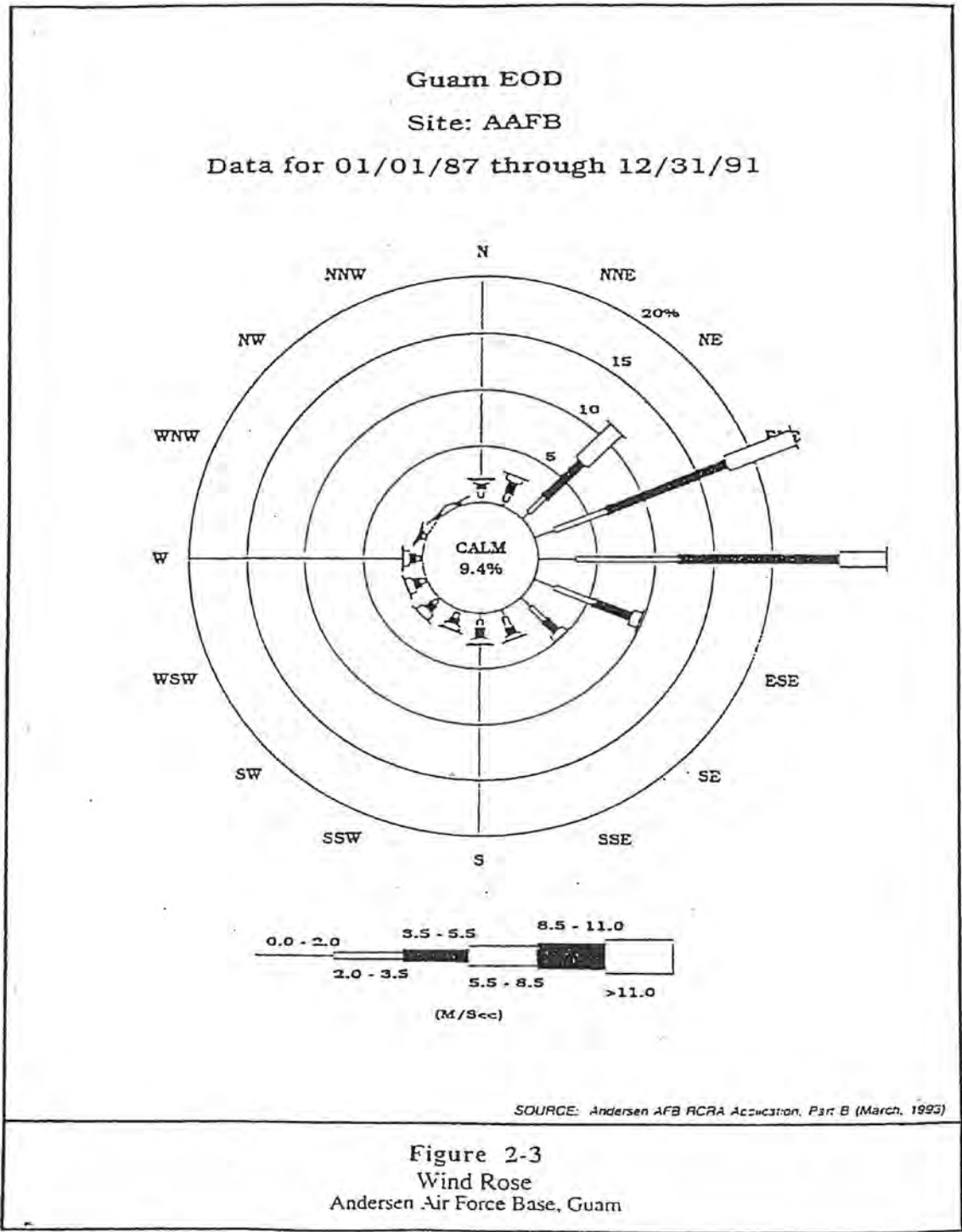


Figure 2-3

### **Section 3: Sampling Program**

The closure sampling program will consist of collecting samples for analysis of soil and groundwater to characterize the extent of potential impacts by OB/OD operations as well as confirmation of completion of closure activities.

Pre-closure soil sampling will be performed to define the vertical and lateral extent of soil contamination within the areas of greatest potential contamination, the OB/OD units. In addition, pre-closure soil, marine surface water, and marine sediment sampling will be performed at other locations on the EOD range outside the immediate vicinity of the units to determine whether contamination is present. Similarly, a final round of groundwater monitoring samples will be collected to evaluate potential impacts and to determine the need for groundwater remediation.

Additional samples (soil clearance sampling, burn kettle wipe sampling) will be collected to evaluate the effectiveness of remedial activities. Samples will also be collected to complete characterization of closure generated waste(s) and investigation derived waste(s).

Locations for each of the sample points are shown in Figures 3-1, for the overall Tarague Basin area and 3-2, for those samples within the immediate vicinity of the EOD Range. The coordinates of these locations are presented in Table 3-2 (Soil Sample Locations) and Table 3-3 (Surface Water Sample Locations). The locations of the sample points will be reestablished prior to initiation of the sampling program.

The rationale for each of these sample locations is presented in Table 3-1. This information presents a description of each sample location and the intent for selecting each of these points.

Each element of the sampling program is discussed separately below.

#### **3.1 *Pre-Closure Samples OB and OD Treatment Units***

Ten shallow soil samples will be collected at each of the OB and OD treatment units, at a rate of one (1) sample per approximately 4,000 ft<sup>2</sup>. Samples will be collected at each location at one-foot depth intervals. (i.e., 0 - 1 foot, 1 - 2 feet, and 2 - 3 feet) Data from these samples will be used to determine the extent of excavation necessary for removal to achieve clean closure.

#### **3.2 *Pre-Closure Samples - Other***

Shallow soil samples will be collected at the 21 locations both on and off the EOD Range HWMF. These same sampled locations were used for the baseline monitoring program as detailed in Figures 3-1 and 3-2. All samples will be collected from the upper 6 inches to avoid disturbance of cultural resources, as they were during the baseline sampling program. Sample matrices include beach sand, jungle soil and "cliff-crest" soil. Sample locations include potential impact locations as well as background locations for each matrix. The rationale for each sample point is summarized in Table 3-1.

In addition, marine surface water and marine sediments samples will be collected at 16 locations to evaluate potential for contamination off site of the EOD Range HWMF. These samples likewise will be the same as those sampled for the baseline program. These locations are depicted in Figures 3-1 and 3-2.

### **3.3 Remedial Action Clearance Samples**

Two types of remedial action clearance samples are anticipated.

#### **3.3.1 Treatment Unit Excavations**

Clearance sampling will be performed in the areas from which contaminated soil was removed to evaluate the effectiveness of the remediation. Grab samples will be collected at a depth interval of 0 - 0.5 feet below the floor (or wall) of the excavation. A grid of one sample per 500 ft<sup>2</sup> of excavation surface area will be used. Clearance sampling will be repeated as necessary to show the remediation has achieved required minimum containment.

#### **3.3.2 Open Burn Containment Device Decontamination Clearance Samples**

Sampling of the burn kettle will be performed after decontamination to evaluate the effectiveness of the remediation. Five (5) wipe samples, each covering a one (1) square foot area, will be collected from the bottom (two samples) and sides (three samples) of the burn kettle inner surface.

### **3.4 Groundwater Samples**

Groundwater sampling will be performed in accordance with the groundwater monitoring plan. This final round of sampling will utilize the sampling locations, sampling procedures and analytical scope and methodology specified for the groundwater monitoring plan.

### **3.5 Closure Generated Waste Samples**

Two (2) types of wastes will be generated by closure activities and will require environmental information for proper disposal or treatment.

#### **3.5.1 Excavated Material**

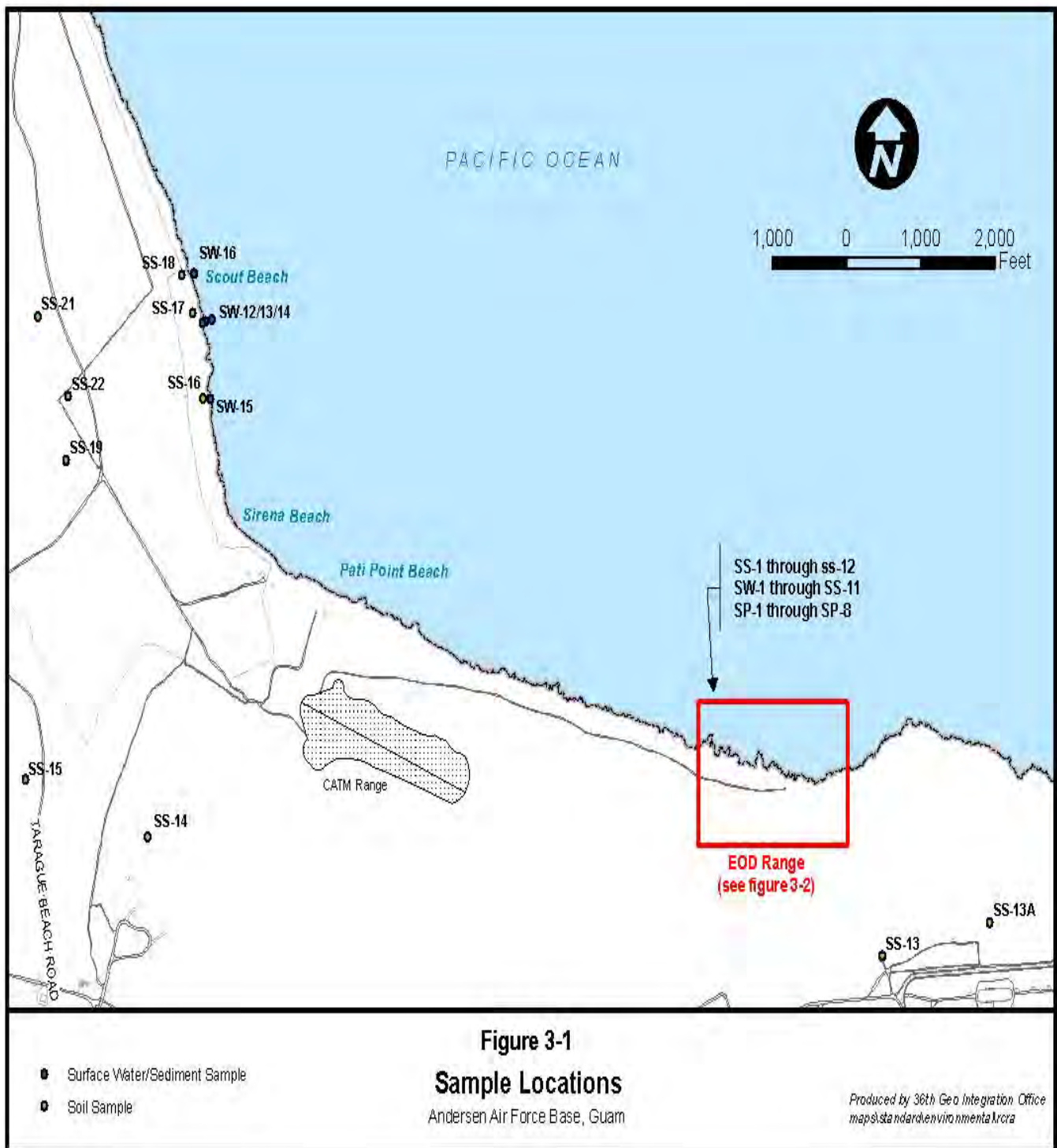
Contaminated soils from treatment units may require additional sampling for full characterization prior to treatment or disposal. Data will be available from the treatment unit evaluation sampling efforts. Additional sampling will be accomplished for only those additional parameters imposed due to waste transport and/or treatment or disposal restrictions.

#### **3.5.2 Investigative or Remediation Derived Wastes**

Similarly, additional characterization sampling will be accomplished for investigative or remediation derived wastes as necessary for proper disposal or treatment. Most of these wastes will be liquid in nature, generated from decontamination of sampling or excavation equipment. Results from sampling data related to these wastes will be available for most, if not all, characterization efforts. Additional sampling will be accomplished for only those additional parameters imposed due to waste transport and/or treatment or disposal restriction.

### **3.6 Quality Assurance**

Additional sampling will be accomplished to provide quality assurance necessary to demonstrate validity of the analytical data and appropriateness of the sampling and equipment decontamination procedures.



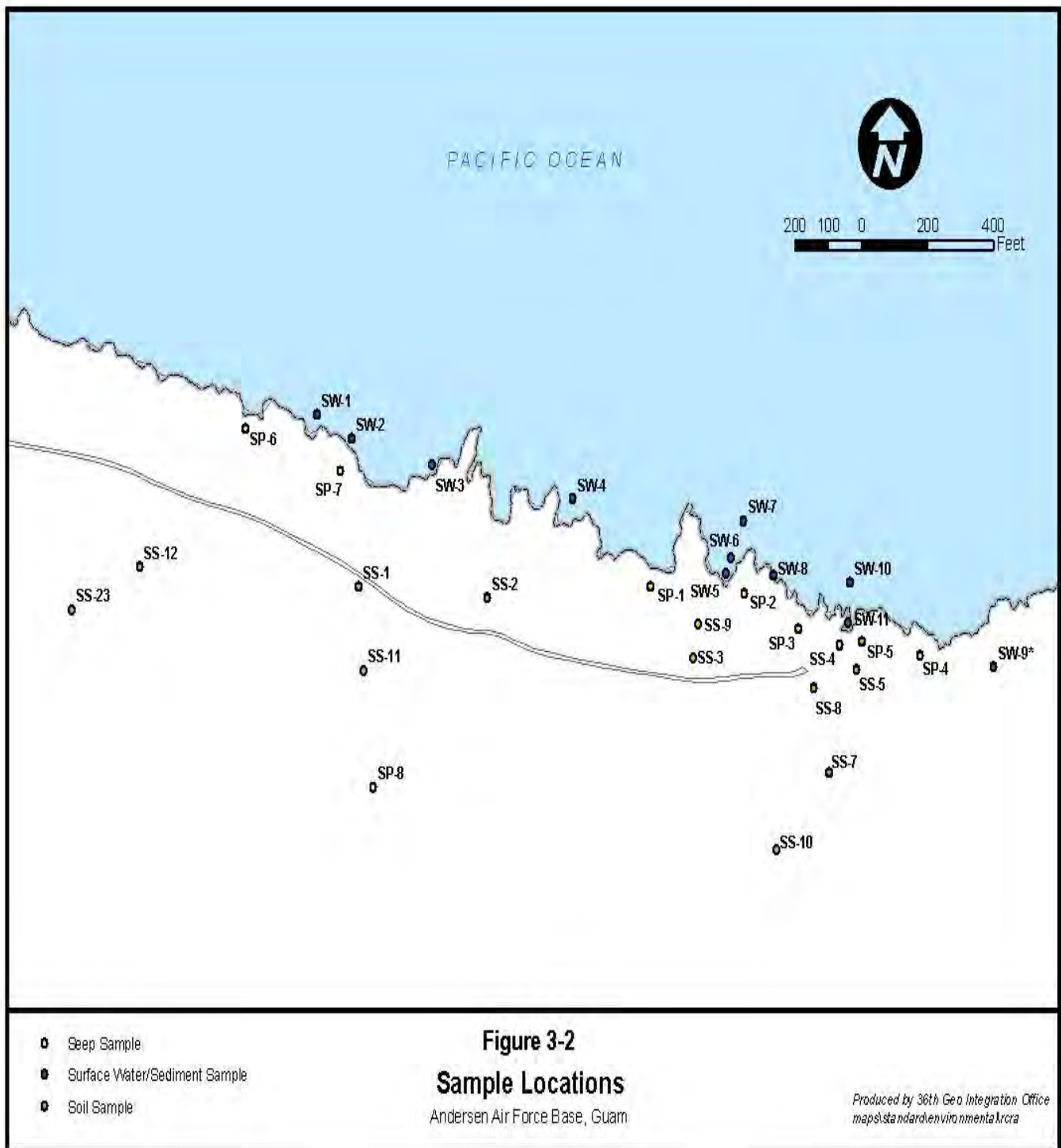


TABLE 3-1: SAMPLE RATIONALE

<b>Shallow Soil Samples</b>				
<b>Sample Matrix</b>	<b>Sample I.D.</b>	<b>Analytical Scope</b>	<b>Sample Location</b>	<b>Sample Rationale</b>
Beach Sand	SS-1	Intermediate	Beach near access road; west side within 1,000 feet radius of OB Unit	Downwind of OB and OD Units
Beach Sand	SS-2	Intermediate	Beach; west side near personnel bunker	Downwind of OB and OD Units; close proximity to personnel bunker
Beach Sand	SS-3	Full and PCBs	Beach; adjacent to OB unit	OB source characterization
Beach Sand	SS-4	Intermediate	Beach; north of OD unit	Near OD Unit
Beach Sand	SS-5	Full	Beach; immediately adjacent to OD unit	Near OD Unit
Rock (pulverized)	SS-6	Full	Material within OD pit	OD source characterization
Jungle Soil	SS-7	Intermediate	Limestone Terrace; east side	Near OD Unit
Beach Sand	SS-8	Intermediate	Beach; west of OD unit	Near OD Unit
Beach Sand	SS-9	Intermediate and PCBs	Beach; north of OB unit	Near OB Unit
Jungle Soil	SS-10	Intermediate	Limestone Terrace; south of OB unit	Near OB and OD Unit
Jungle Soil	SS-11	Intermediate	Jungle; west of OB and OD Units; within 1000 feet radius of OB Unit	Downwind of OB and OD Units
Jungle Soil	SS-12	Intermediate	Jungle; west of OB and OD units; outside 1,000 feet radius of OB Unit	Downwind of OB and OD Units
Cliff-Crest Soil	SS-13	Intermediate	Crest of Cliff; 2,200 feet southeast of OB and OD Units	Background
Cliff-Crest Soil	SS-13A	Short	Crest of Cliff; 3,200 feet southeast of OB and OD Units	Background
Cliff-Crest Soil	SS-14	Full	Crest of Cliff; 8,400 feet west of OB and OD Units	Downwind of OB and OD Units
Cliff-Crest Soil	SS-15	Intermediate	Crest of Cliff; 10,000 feet west of OB and OD Units	Downwind of OB and OD Units
Beach Sand	SS-16	Short	Beach at Scout Beach; south	Downwind of OB and OD Units
Beach Sand	SS-17	Intermediate	Beach at Scout Beach; center	Background
Beach Sand	SS-18	Short	Beach at Scout Beach; north	Background
Jungle Soil	SS-19	Short	Jungle at Scout Beach; south	Background
Jungle Soil	SS-20	Intermediate	Jungle at Scout Beach; center	Background
Jungle Soil	SS-21	Short	Jungle at Scout Beach; north	Background
Jungle Soil	SS-22	Short	Jungle, west of OB and OD units, within 1,000 feet radius of OB Unit	Downwind of OB and OD Units
Jungle Soil	SS-23	Intermediate	Jungle, west of OB and OD units, within 1,000 feet radius of OB Unit	Downwind of OB and OD Units

TABLE 3-1: SAMPLE RATIONALE

<b>Marine Surface Water/Sediment (1)</b>				
Marine/Water Sediments	SW/SED-1	Short	Central “reef flat” (2); 1,350 feet west-northwest of OB Unit	Downdrift of OB and OD Units; not associated with a seep
Marine/Water Sediments	SW/SED-2	Intermediate	Central “reef flat” (2); 1,225 feet west-northwest of OB Unit	Downdrift of OB and OD Units; associated with seep SP-7
Marine/Water Sediments	SW/SED-3	Short	Central “reef flat” (2); 1,000 feet west of OB Unit	Downdrift of OB and OD Units; not associated with a seep
Marine/Water Sediments	SW/SED-4	Short	Central “reef flat” (2); 550 feet west of OB Unit	Downdrift of OB and OD Units; not associated with a seep
Marine/Water Sediments	SW/SED-5	Intermediate	N-S transect at OB Unit; immediately seaward of SP-2, nearshore	Associated with seep SP-2 (highest potential impact for OB Unit)
Marine/Water Sediments	SW/SED-6	Intermediate	N-S transect at OB Unit; immediately seaward of SP-2, nearshore	Associated with seep SP-2 (highest potential impact for OB Unit)
Marine/Water Sediments	SW/SED-7	Full	N-S transect at OB Unit; immediately seaward of SP-2, nearshore	Associated with seep SP-2 (highest potential impact for OB Unit)
Marine/Water Sediments	SW/SED-8	Intermediate	Beach at Scout Beach; center	Between OB and OD Units; not associated with a seep
Marine/Water Sediments	SW/SED-9	Full	Beach at Scout Beach; north	Associated with seep SP-4 (second highest potential impact for OD Unit)
Marine/Water Sediments	SW/SED-10	Full	N-S transect at OB Unit; immediately seaward of SP-2, nearshore	Associated with seep SP-5 (highest potential impact for OB Unit)
Marine/Water Sediments	SW/SED-11	Full	N-S transect at OB Unit; immediately seaward of SP-2, nearshore	Associated with seep SP-5 (highest potential impact for OD Unit)
Marine/Water Sediments	SW/SED-12	Intermediate	N-S transect at OB Unit; immediately seaward of SP-2, nearshore	Background
Marine/Water Sediments	SW/SED-13	Short	N-S transect at OB Unit; immediately seaward of SP-2, nearshore	Background
Marine/Water Sediments	SW/SED-14	Intermediate	N-S transect at OB Unit; immediately seaward of SP-2, nearshore	Background
Marine/Water Sediments	SW/SED-15	Short	Central “reef flat” (2); Scout Beach	Background
Marine/Water Sediments	SW/SED-16	Intermediate	Central “reef flat” (2); at Scout Beach	Background
<b>Groundwater (Seep/Cave)</b>				
Groundwaters	DGW - 1 DGW - **	As per Detection Monitoring Plan	Various, in accordance with Detection Monitoring Plan	Point of Compliance for groundwater

TABLE 3-1: SAMPLE RATIONALE

<b>Treatment Unit Soils</b>				
Open Detonation Treatment Unit Soils	OD-1 through OD-5	Full	Grid across entire OD Treatment Unit, one sample per 4,000 ft sq; 3 samples depths (0-1 ft), (1-2 ft), (2-3 ft) per location	Evaluation for presence of contamination requiring removal for disposal/treatment
Open Burning Treatment Unit Soils	OB-1 through OB-5	Full	Grid across entire OD Treatment Unit, one sample per 4,000 ft sq; 3 samples depths (0-1 ft), (1-2 ft), (2-3 ft) per location	Evaluation for presence of contamination requiring removal for disposal/treatment
<b>Remedial Action Clearance Samples</b>				
Treatment Unit Excavations	RAC - 1 RAC - **	As necessary	As necessary within treatment units	Confirmation of adequate extent of excavation and removal for treatment or disposal
OB Containment Device Decontamination Clearance	OBCD - 1 OBCD - **	Full	Inside bottom of device (OBCD-1, OBCD-2); inside walls of device (OBCD-3 thru OBCD-5)	Decontamination clearance sample
<b>Closure Generated Waste</b>				
Excavated Soils	ES - 1 ES - **	As necessary	From stockpiled material in accordance SW-846 methods	Additional information as necessary to characterize material for treatment or disposal
Investigative or Remediation Equipment Decontamination Derived Wastes	IDW - 1 IDW - **	As necessary	From temporary stored material in accordance with SW-846 methods	Additional information as necessary to characterize material for treatment or disposal

- (1) Each marine surface water sample was collected at the associated sediment sample location (both samples from the same x,y location)
- (2) Potential environmental impact based on proximity to the unit, seep flow rate, and other pertinent observations.
- (3) “Central reef flat” means midway between shore and inner edge of dead coral reef.

TABLE 3-2: SOIL SAMPLE LOCATIONS

POINT	NORTH	EAST
SS-1	209942.60	225059.06
SS-2	209923.00	225448.25
SS-3	209800.84	226070.67
SS-4	209840.00	226581.05
SS-5	209779.98	226565.46
SS-7	209560.53	226483.87
SS-8	209740.00	226436.42
SS-9	209873.65	226085.57
SS-10	209395.00	226326.51
SS-11	209764.56	225074.96
SS-12	209978.93	224396.95
SS-13	208193.98	227742.94
SS-13A	208523.02	229188.86
SS-16	213385.46	218537.40
SS-17	214189.59	218389.17
SS-18	214543.07	218238.34
SS-19	212778.71	216697.60
SS-21	214134.82	216303.95
SS-22	213382.82	216716.17

TABLE 3-3: SURFACE WATER SAMPLE LOCATIONS

POINT	NORTH	EAST
SW-1	210308.14	224929.28
SW-2	210258.56	225034.42
SW-3	210204.21	225277.97
SW-4	210136.43	225703.11
SW-5	209982.12	226168.15
SW-6	210015.60	226183.89
SW-7	210093.43	226220.48
SW-8	209978.96	226312.88
SW-9*	209790.00	226979.00
SW-10	209965.89	226544.20
SW-11	209880.30	226539.11
SW-12	214133.04	218653.38
SW-13	214106.53	218563.19
SW-14	214095.81	218526.74
SW-15	213375.11	218640.61
SW-16	214561.65	218408.87

## **SECTION 4: Sampling Procedures**

The following section outlines the procedures to be employed in collection of the required samples.

### **4.1 *Shallow Soils***

The following procedures will be employed in collection of shallow soil samples as of the pre-closure, treatment unit evaluation, and remediation clearance sampling programs.

#### **4.1.1 Pre-closure**

Sample points will be relocated using appropriate means, likely by surveying. Following completion of the baseline sampling program, the sample locations were surveyed relative to the established AAFB coordinate grid system. Surveying will be used to re-establish those sample locations which cannot be positively identified through other means (observation of remaining flagging or other identification).

The shallow surface soil samples for the pre-closure sampling program will be collected using stainless steel spoons. The sample will be collected directly into their respective sample containers for labeling and shipment to the analytical laboratory.

#### **4.1.2 Treatment Unit Evaluation**

Soil samples will be collected for the treatment unit evaluation using a hand core sampler, as the samples will be from slightly greater depths. The soil samples will be placed into their respective sample containers directly from the core sampler unit.

Following sample collection, the ground surface at each sample location will be backfilled with investigation derived material as necessary. Treatment unit evaluation samples will be marked with a labeled survey flag. Each sample point will be surveyed and placed on a site plan for use in presenting analytical results and evaluating remedial steps necessary.

#### **4.1.3 Remediation Clearance**

Remediation clearance samples will be collected directly from the extent of the excavation to demonstrate effectiveness of the remedial action. Sampling will also use pre-decontaminated spoons. Samples will be placed directly into sample containers for transport to the analytical laboratory.

### **4.2 *Groundwater***

Groundwater samples will be collected in accordance with the procedures specified in the groundwater monitoring plan. As such, they will represent a continuation of the same data set as established by the ongoing groundwater monitoring plan.

### **4.3 *Marine Surface Water***

Marine surface water samples will be collected from eleven (11) locations at the EOD range and five (5) background locations at Scout Beach. All sample locations will be on the reef flat (between the beach and the reef). No samples will be collected on the reef itself or north of the reef. The reef flat is shallow and all samples locations are to be accessible by walking/wading.

Marine surface water samples will be collected by submerging the sample container into the surface water until it is filled. When surface water flow is present, the container's opening will be positioned to face upstream while the sampling personnel stand downstream to avoid stirring up sediments that could contaminate the sample. The pH, specific conductance, dissolved oxygen, and temperature will be measured at each location and recorded in the field notebook, along with other pertinent site conditions.

At the start of each sampling day, the pH meter will be calibrated in accordance with manufacturer's instructions and documented on calibration forms in the field notebook. Immediately prior to sampling, all sample containers will be properly labeled using waterproof ink. All samples will have preservatives added after sample collection and placed in a cooler with ice to maintain a temperature of 4 degrees Celsius (°C).

#### **4.4     *Marine Sediments***

Nine (9) surface soil samples will be collected, to include three (3) background samples at Scout Beach. All soil samples will be collected from the upper six (6) inches to avoid impacting cultural resources. Surface soil samples will be collected using decontaminated stainless steel spoons, pre-cleaned in the laboratory prior to being transported to the site. Each spoon will be used for one sampling location.

#### **4.5     *Closure Generated Wastes***

Sampling for these materials will be limited to those parameters necessary to adequately characterize these wastes for determination of treatment or disposal methods. Sample analysis is likely to be limited as the nature of these wastes will be relatively well known based upon the data from the soils or wastes handled.

##### **4.5.1   Contaminated Soils**

Sampling of the closure generated waste contaminated soils will be accomplished using a combination of hand tools, pre-decontaminated spoons and/or manual soil core units as appropriate.

##### **4.5.2   Remediation Equipment Decontamination Wastes**

Samples of the remediation equipment decontamination wastewater will be collected using disposable sample bailers. Sampling of the OB treatment unit containment device wastewaters will likewise use disposable bailers to extract samples from the temporary wastewater storage container(s).

##### **4.5.3   Investigative Derived Wastes**

Sampling of investigative derived wastewaters will also be accomplished using disposable bailers. Personnel protective equipment (PPE) wastes will likely not be sampled, rather other available data will be used to evaluate proper disposal requirements.

#### **4.6     *Sampling Equipment Decontamination Procedures***

Sampling equipment will be properly decontaminated prior to use in collection of samples for analysis. Procedures will consist of generally recognized steps of: general cleaning, organic solvent rinse, and nitric acid rinse (for samples requiring metal analysis).

Shallow soils sampling equipment will likely consist of stainless steel spoons as were used in the baseline sampling program. These sampling spoons are to be pre-cleaned in the laboratory with detergent wash

followed by an organic solvent rinse. After air drying, they will be wrapped in aluminum foil for transport to the site for use. Since each sampling spoon will be used only once, there is no need for the decontamination on-site.

Sampling equipment intended for collection of more than one (1) sample (shallow soil core equipment) will be decontaminated between sample locations in a similar manner to their initial decontamination procedure.

Wastewater will be sampled using single use, pre-cleaned disposable bailers. As such, no field decontamination procedures are required.

## **Section 5: Analytical Scope and Procedures**

The following section presents the scope of analyses and procedures specified for analyses. In general, the overall impact evaluation samples are grouped, as they were in the baseline sampling program, into three (3) categories for analyses: short, intermediate, and full scope groups of analyses. Short analytical list parameters consist of ammonia, total kjeldahl nitrogen (TKN), nitrate and nitrite, and inductively couple argon plasma (ICAP) metals, plus mercury. Intermediate analytical list parameters consists of cyanide, volatile organics, and semi-volatile organics in addition to ammonia, TKN, nitrate and nitrite, total PO, and ICAP metals, plus mercury and explosives. The full scope analytical list adds nitrocellulose, nitroglycerin, pentaerythritols, tetranitrate (PETN) and white phosphorus in addition to the intermediate analytical list parameters. In addition to the above parameters, selected samples will be analyzed for PCBs.

### **5.1 *Pre-Closure Samples – OB/OD Treatment Units***

Soil samples will be analyzed for approximately 113 compounds potentially associated with OB and OD operations, including metals, volatile organics, semi-volatile organics, and explosive/energetics. Analyses will be performed in accordance with USEPA approved procedures when available. USATHAMA procedures will be used for explosives, due to the lack of an USEPA method. Similarly, white phosphorus will be analyzed in accordance with a laboratory developed method. Target analyses and their associated analytical methods and reporting limits are presented in Table 5-2.

### **5.2 *Pre-Closure Samples – EOD Range, Other***

The shallow soil, marine surface water, and marine sediment samples collected will be analyzed for the same potential contaminants evaluated for the baseline program, i.e. varying from short, intermediate to full scope analyses. These various lists include metals, volatile organics, semi-volatile organics, and explosives/energetics.

### **5.3 *Remedial Action Clearance Samples***

Shallow soil samples collected for the evaluation of remedial action effectiveness will be analyzed only for the contaminants of concern, which prompted that remedial action. For example, if the remedial action was undertaken due to contamination by one or more particular metals, the clearance sample will be limited to those contaminants.

### **5.4 *Groundwater Samples***

Groundwater samples will be analyzed for the parameters in the Groundwater Monitoring Plan in accordance with the method specified therein.

#### **5.5     *Equipment Decontamination Clearance Samples***

Equipment decontamination clearance samples will be analyzed only for those hazardous waste characteristic parameters potentially present. The potential contaminants will be known as the contaminants present in the materials handled by the equipment will have been characterized. If the equipment decontamination wastes are characterized as non-hazardous, alternate sampling and analyses may be required to address other non-hazardous waste disposal concerns prior to disposal.

#### **5.6     *Open Burn Containment Device Wipe Samples***

Open burn containment device wipe samples will be analyzed for hazardous waste characteristics to provide data with respect to disposal concerns or restrictions.

#### **5.7     *Closure Generated Wastes***

Closure generated wastes including excavated contaminated soils, decontamination wastewaters from investigation and remediation equipment, will be analyzed for a limited suite of parameters. The specific parameters will be determined by the data need of the proposed disposal/treatment method for these wastes which exceed appropriate data generated by other portions of the closure sampling program.

TABLE 5-1: ANALYTICAL PARAMETERS

Sample Matrix	Sample I.D.	Analytical Scope	Metals	Cyanide	Volatile Organics	Semi-Volatile Organics	Explosives		
							Group A	Group B	Group C
Shallow Soil Samples	SS-1	Intermediate	X	X	X	X	X	X	
	SS-2	Intermediate	X	X	X	X	X	X	
	SS-3	Full	X	X	X	X	X	X	X
	SS-4	Intermediate	X	X	X	X	X	X	
	SS-5	Full	X	X	X	X	X	X	X
	SS-6	Full	X	X	X	X	X	X	X
	SS-7	Intermediate	X	X	X	X	X	X	
	SS-8	Intermediate	X	X	X	X	X	X	
	SS-9	Intermediate	X	X	X	X	X	X	
	SS-10	Intermediate	X	X	X	X	X	X	
	SS-11	Intermediate	X	X	X	X	X	X	
	SS-12	Intermediate	X	X	X	X	X	X	
	SS-13	Intermediate	X	X	X	X	X	X	
	SS-13A	Short	X						
	SS-14	Full	X	X	X	X	X	X	X
	SS-15	Intermediate	X	X	X	X	X	X	
	SS-16	Short	X						
	SS-17	Intermediate	X	X	X	X	X	X	
	SS-18	Short	X						
	SS-19	Short	X						
	SS-20	Intermediate	X	X	X	X	X	X	
	SS-21	Short	X						
	SS-22	Short	X						
	SS-23	Short	X						

TABLE 5-1: ANALYTICAL PARAMETERS

Sample Matrix	Sample I.D.	Analytical Scope	Metals	Cyanide	Volatile Organics	Semi-Volatile Organics	Explosives		
							Group A	Group B	Group C
Marine Sediment Samples	SED-1	Short	X						
	SED-2	Intermediate	X	X	X	X	X	X	X
	SED-3	Short	X						
	SED-4	Short	X						
	SED-5	Intermediate	X	X	X	X	X	X	
	SED-6	Intermediate	X	X	X	X	X	X	
	SED-7	Full	X	X	X	X	X	X	X
	SED-8	Intermediate	X	X	X	X	X	X	
	SED-9	Full	X	X	X	X	X	X	X
	SED-10	Full	X	X	X	X	X	X	X
	SED-11	Full	X	X	X	X	X	X	X
	SED-12	Intermediate	X	X	X	X	X	X	
	SED-13	Short	X						
	SED-14	Intermediate	X	X	X	X	X	X	
	SED-15	Short	X						
	SED-16	Short	X	X	X	X	X	X	
Marine Surface Water Samples	SW-1	Short	X						
	SW-2	Intermediate	X	X	X	X	X		
	SW-3	Short	X						
	SW-4	Short	X						
	SW-5	Intermediate	X	X	X	X	X		
	SW-6	Intermediate	X	X	X	X	X		
	SW-7	Full	X	X	X	X	X	X	X
	SW-8	Intermediate	X	X	X	X	X		
	SW-9	Full	X	X	X	X	X	X	X

TABLE 5-1: ANALYTICAL PARAMETERS

Sample Matrix	Sample I.D.	Analytical Scope	Metals	Cyanide	Volatile Organics	Semi-Volatile Organics	Explosives		
							Group A	Group B	Group C
	SW-10	Full	X	X	X	X	X	X	X
	SW-11	Full	X	X	X	X	X	X	X
	SW-12	Intermediate	X	X	X	X	X		
	SW-13	Short	X						
	SW-14	Intermediate	X	X	X	X	X		
	SW-15	Short	X						
	SW-16	Intermediate	X	X	X	X	X		
Ground waters	DGW - 1	As per Detection Groundwater Monitoring Plan							
	DGW - **								
Treatment Unit Soils	OD-1	Full	X	X	X	X	X	X	X
	OD-2	Full	X	X	X	X	X	X	X
	OD-3	Full	X	X	X	X	X	X	X
	OD-4	Full	X	X	X	X	X	X	X
	OD-5	Full	X	X	X	X	X	X	X
	OB-1	Full	X	X	X	X	X	X	X
	OB-2	Full	X	X	X	X	X	X	X
	OB-3	Full	X	X	X	X	X	X	X
	OB-4	Full	X	X	X	X	X	X	X
	OB-5	Full	X	X	X	X	X	X	X
Remedial Action Clearance Samples	RAC - 1	As necessary for final closure clearance							
	RAC - **								
	OBCD - 1	Full							
	OBCD - **								

TABLE 5-1: ANALYTICAL PARAMETERS

Sample Matrix	Sample I.D.	Analytical Scope	Metals	Cyanide	Volatile Organics	Semi-Volatile Organics	Explosives		
							Group A	Group B	Group C
Closure Generated Waste	ES - 1	As necessary for disposal/treatment characterizations							
	ES - **								
	IDW - 1	As necessary for disposal/treatment characterizations							
	IDW - **								

TABLE 5-2: TARGET ANALYTES. ANALYTICAL METHODS AND REPORTING LIMITS

Analyte	Solid Samples			Water Samples		
	Method	Reporting Limit	Concentration Unit	Method	Reporting Limit	Concentration Unit
<b>Nutrients:</b>						
Ammonia	CE-81-1	6.5	mg/kg - dry	350.1	0.05	mg/L
TKN	CE-81-1	10.0	mg/kg - dry	351.2	0.10	mg/L
Nitrate and Nitrite	9056A	4.0	mg/kg - dry	353.2	0.01	mg/L
Phosphorus PO4	9056A	2.5	mg/kg - dry	365.1	0.01	mg/L
<b>Metals:</b>						
Aluminum	6010C	10.0	mg/kg - dry	6010C	50.00	mg/L <sup>2</sup>
Antimony	6010C	5.0	mg/kg - dry	6020A	0.50	mg/L
Arsenic	6010C	10.0	mg/kg - dry	6020A	1.00	mg/L
Barium	6010C	2.0	mg/kg - dry	6020A	0.50	mg/L
Beryllium	6010C	0.5	mg/kg - dry	6020A	0.20	mg/L
Cadmium	6010C	0.39	mg/kg - dry	6020A	0.10	mg/L
Calcium	6010C	75.0	mg/kg - dry	6010C	0.10	mg/L
Chromium	6010C	1.0	mg/kg - dry	6020A	1.00	mg/L
Cobalt	6010C	2.0	mg/kg - dry	6020A	0.50	mg/L
Copper	6010C	0.5	mg/kg - dry	6020A	0.50	mg/L
Iron	6010C	25.0	mg/kg - dry	6010C	45.00	mg/L
Lead	6010C	10.0	mg/kg - dry	6020A	0.50	mg/L
Magnesium	6010C	25.0	mg/kg - dry	6010C	0.05	mg/L
Manganese	6010C	2.5	mg/kg - dry	6020A	0.50	mg/L
Mercury	7471B	0.1	mg/kg - dry	7470A	0.20	mg/L
Molybdenum	6010C	1.0	mg/kg - dry	6020A	1.00	mg/L
Nickel	6010C	2.0	mg/kg - dry	6020A	1.00	mg/L
Potassium	6010C	100.0	mg/kg - dry	6010C	0.60	mg/L
Selenium	6010C	10.0	mg/kg - dry	6020A	2.00	mg/L
Silver	6010C	0.5	mg/kg - dry	6020A	0.10	mg/L
Sodium	6010C	50.0	mg/kg - dry	6010C	0.10	mg/L
Strontium	6010C	2.0	mg/kg - dry	6010C	2.50	mg/L
Thallium	6010C	20.0	mg/kg - dry	6020A	0.10	mg/L
Tin	6010C	5.0	mg/kg - dry	6010C	0.20	mg/L
Titanium	6010C	2.0	mg/kg - dry	6010C	1.00	mg/L
Vanadium	6010C	1.0	mg/kg - dry	6010C	1.00	mg/L
Zinc	6010C	5.0	mg/kg - dry	6010C	2.00	mg/L
Cyanide	9010C	0.3	mg/kg - dry	9010C	5.00	mg/L
<b>Volatile Organics:</b>						
Benzene	8021B	100.0	ug/kg - dry	8021B	1.00	ug/L
Ethyl Benzene	8021B	100.0	ug/kg - dry	8021B	1.00	ug/L

TABLE 5-2: TARGET ANALYTES. ANALYTICAL METHODS AND REPORTING LIMITS

Analyte	Solid Samples			Water Samples		
	Method	Reporting Limit	Concentration Unit	Method	Reporting Limit	Concentration Unit
Toluene	8021B	100.0	ug/kg - dry	8021B	1.00	ug/L
Xlyenes-Total	8021B	100.0	ug/kg - dry	8021B	1.00	ug/L
O-Xylene	8021B	100.0	ug/kg - dry	8021B	1.00	ug/L
M-and/or P-Xylene	8021B	100.0	ug/kg - dry	8021B	1.00	ug/L
<b><i>Semi-Volatile Organics:</i></b>						
Acenaphthalene	8270D	70	ug/kg - dry	8270D	1.0	ug/L
Acenathphtylene	8270D	70	ug/kg - dry	8270D	1.0	ug/L
Anthracene	8270D	70	ug/kg - dry	8270D	1.0	ug/L
Benzyl alcohol	8270D	140	ug/kg - dry	8270D	2.0	ug/L
Benzoic acid	8270D	1,350	ug/kg - dry	8270D	30.0	ug/L
Benzo(a)anthracene	8270D	100.0	ug/kg - dry	8270D	1.5	ug/L
Benzo(b)fluoranthene	8270D	100.0	ug/kg - dry	8270D	1.5	ug/L
Benzo(k)fluoranthene	8270D	100.0	ug/kg - dry	8270D	1.5	ug/L
Benzo(a)pyrene	8270D	140.0	ug/kg - dry	8270D	2.0	ug/L
Benzo(ghi)perylene	8270D	160.0	ug/kg - dry	8270D	2.5	ug/L
Butylbenzylphthalate	8270D	100.0	ug/kg - dry	8270D	1.5	ug/L
Bis(2-chloroethyl)ether	8270D	70.0	ug/kg - dry	8270D	1.5	ug/L
Bis(2-chloroethoxy)methane	8270D	70.0	ug/kg - dry	8270D	1.0	ug/L
Bis(2-ethylhexyl)phthalate	8270D	100.0	ug/kg - dry	8270D	2.0	ug/L
Bis(2-chloroisopropyl)ether	8270D	70.0	ug/kg - dry	8270D	1.0	ug/L
4-Bromophenylphenylether	8270D	140.0	ug/kg - dry	8270D	1.0	ug/L
4-Chloroaniline	8270D	300.0	ug/kg - dry	8270D	4.0	ug/L
2-Chloronaphthalene	8270D	70.0	ug/kg - dry	8270D	1.0	ug/L
2-Chlorophenol	8270D	140.0	ug/kg - dry	8270D	2.0	ug/L
4-Chlor-3-Mehtylphenol	8270D	140.0	ug/kg - dry	8270D	1.5	ug/L
4-Chlorophenylphenylether	8270D	100.0	ug/kg - dry	8270D	1.0	ug/L
Chrysene	8270D	100.0	ug/kg - dry	8270D	1.5	ug/L
Dibenzo(a,h)anthracene	8270D	160.0	ug/kg - dry	8270D	2.5	ug/L
Dibenzofuran	8270D	70.0	ug/kg - dry	8270D	1.0	ug/L
Di-n-butylphthalate	8270D	70.0	ug/kg - dry	8270D	1.0	ug/L
1,3-Dichlorobenzene	8270D	70.0	ug/kg - dry	8270D	1.0	ug/L
1,2-Dichlorobenzene	8270D	70.0	ug/kg - dry	8270D	1.0	ug/L
1,4-Dichlorobenzene	8270D	70.0	ug/kg - dry	8270D	1.0	ug/L
3,3-dichlorobenzidine	8270D	500.0	ug/kg - dry	8270D	5.00	ug/L
2,4-Dichlorophenol	8270D	140.0	ug/kg - dry	8270D	2.00	ug/L
Diethyl phthalate	8270D	70.0	ug/kg - dry	8270D	1.00	ug/L
2,4-Dimehtylphenol	8270D	140.0	ug/kg - dry	8270D	2.00	ug/L
Dimethyl pthalate	8270D	100.0	ug/kg - dry	8270D	2.00	ug/L

TABLE 5-2: TARGET ANALYTES. ANALYTICAL METHODS AND REPORTING LIMITS

Analyte	Solid Samples			Water Samples		
	Method	Reporting Limit	Concentration Unit	Method	Reporting Limit	Concentration Unit
2,4-Dinitrophenol	8270D	1300.0	ug/kg - dry	8270D	30.00	ug/L
2,4-Dinitrotoluene	8270D	140.0	ug/kg - dry	8270D	2.00	ug/L
2,6-Dinitrotoluene	8270D	140.0	ug/kg - dry	8270D	2.00	ug/L
Di-n-octylththalate	8270D	140.0	ug/kg - dry	8270D	2.40	ug/L
Fluoranthene	8270D	70.0	ug/kg - dry	8270D	1.00	ug/L
Fluorene	8270D	70.0	ug/kg - dry	8270D	1.00	ug/L
Hexachlorobenzene	8270D	100.0	ug/kg - dry	8270D	2.00	ug/L
Hexachlorobudatiene	8270D	140.0	ug/kg - dry	8270D	2.00	ug/L
Hexachlorocyclopentadiene	8270D	1000.0	ug/kg - dry	8270D	10.00	ug/L
Hexachloroethane	8270D	100.0	ug/kg - dry	8270D	1.50	ug/L
Indeno(1,2,3-cd)pyrebe	8270D	160.0	ug/kg - dry	8270D	2.50	ug/L
Isophorone	8270D	140.0	ug/kg - dry	8270D	1.00	ug/L
2-methylnaphthalene	8270D	100.0	ug/kg - dry	8270D	1.00	ug/L
2-Methyl-1,6-dinitrophenol	8270D	1000.0	ug/kg - dry	8270D	20.00	ug/L
2-Methylphenol	8270D	140.0	ug/kg - dry	8270D	2.00	ug/L
4-Methylphenol	8270D	140.0	ug/kg - dry	8270D	2.00	ug/L
Naphthalene	8270D	70.0	ug/kg - dry	8270D	1	ug/L
2-Nitroaniline	8270D	300.0	ug/kg - dry	8270D	5	ug/L
3-Nitroaniline	8270D	300.0	ug/kg - dry	8270D	5	ug/L
4-Nitroaniline	8270D	300.0	ug/kg - dry	8270D	5	ug/L
Nitrobenzene	8270D	70.0	ug/kg - dry	8270D	1	ug/L
2-Nitrophenol	8270D	140.0	ug/kg - dry	8270D	2	ug/L
4-Nitrophenol	8270D	500.0	ug/kg - dry	8270D	10	ug/L
N-nitrosodi-n-propylamine	8270D	100.0	ug/kg - dry	8270D	10	ug/L
N-nitrosodiphenylamine	8270D	70.0	ug/kg - dry	8270D	1	ug/L
Pentachlorophenol	8270D	500.0	ug/kg - dry	8270D	10	ug/L
Phenanthrene	8270D	70.0	ug/kg - dry	8270D	1	ug/L
Phenol	8270D	140.0	ug/kg - dry	8270D	2	ug/L
Pyrene	8270D	70.0	ug/kg - dry	8270D	1	ug/L
1,2,4-Trichlorobenzene	8270D	100.0	ug/kg - dry	8270D	1	ug/L
2,4,6-Trichlorophenol	8270D	300.0	ug/kg - dry	8270D	4.5	ug/L
2,4,5-Trichlorophenol	8270D	300.0	ug/kg - dry	8270D	4	ug/L
<b>Explosive/Energetics:</b>						
<b>Group A</b>						
2-Amino,4,6-dinitrotoluene				UW32	0.15	ug/L
4-Amino,2,6-dinitrotoluene				UW32	0.15	ug/L
1,3-Dinitrotoluene	LW12	0.20	mg/kg - dry	UW32	0.1	ug/L
2,4-Dinitrotoluene	LW12	0.15	mg/kg - dry	UW32	0.06	ug/L

TABLE 5-2: TARGET ANALYTES. ANALYTICAL METHODS AND REPORTING LIMITS

Analyte	Solid Samples			Water Samples		
	Method	Reporting Limit	Concentration Unit	Method	Reporting Limit	Concentration Unit
2,6-Dinitrotoluene	LW12	0.20	mg/kg - dry	UW32	0.07	ug/L
HMX	LW12	0.50	mg/kg - dry	UW32	0.25	ug/L
Nitrobenzene	LW12	0.30	mg/kg - dry	UW32	0.2	ug/L
2-Nitrotoluene	LW12	0.50	mg/kg - dry	UW32	0.25	ug/L
3-Nitrotoluene	** 1		mg/kg - dry	UW32	0.25	ug/L
4-Nitrotoluene	** 1		mg/kg - dry	UW32	0.3	ug/L
RDX	LW12	0.50	mg/kg - dry	UW32	0.25	ug/L
Tetryl	LW12	0.30	mg/kg - dry	UW32	0.2	ug/L
1,3,5-Trinitrobenzene	LW12	0.25	mg/kg - dry	UW32	0.2	ug/L
2,4,6-Trinitrotoluene	LW12	0.25	mg/kg - dry	UW32	0.15	ug/L
<b>Group B</b>						
Nitroglycerine	LW12	4.0	mg/kg - dry	UW19	20	ug/L
PETN	LW12	4.0	mg/kg - dry	UW19	10	ug/L
<b>Group C</b>						
Nitrocellulose	LF03	10.5	mg/kg - dry	UF03	553	ug/L
White Phosphorus	** 2	0.07	mg/kg - dry	** 2	0.03	ug/L
<b>PCBs</b>						
PCB - 1016	8081B	60.0	ug/kg - dry	** 3		
PCB - 1221	8081B	60.0	ug/kg - dry	** 3		
PCB - 1232	8081B	60.0	ug/kg - dry	** 3		
PCB - 1242	8081B	60.0	ug/kg - dry	** 3		
PCB - 1248	8081B	60.0	ug/kg - dry	** 3		
PCB - 1254	8081B	60.0	ug/kg - dry	** 3		
PCB - 1260	8081B	60.0	ug/kg - dry	** 3		

\*\* 1 Solid samples not analyzed for these analytes

\*\* 2 Gas Chromatograph/flame photometric detector (GC/FPD) - ESE Internal Standard

\*\* 3 Water samples not analyzed for these samples

## **Section 6: QA Project Plan**

### **6.1 General Requirements**

Critical objectives for each field team member are to:

1. Collect a sample that is representative of the matrix being sampled; and
2. Maintain sample integrity from the time of sample collection to receipt by the laboratory.

All field notes will be recorded in indelible ink on standard forms in bound notebooks. The field team leader will complete a daily field trip log form. This form will be signed and dated daily. Significant events occurring during the day will be reported to the base project manager at the end of each day's activities. Daily communication is essential to ensure that timely corrective actions can be implemented, if necessary.

All forms in the field notebook(s) must provide for the team members to sign and date the entries. The field team leader must review all field notes and document approval of these notes by either signing each page or stating that the notes were reviewed.

Pre-field meetings/conference calls will be held prior to field investigation. These meetings are intended to ensure that all laboratory and field personnel are aware of the field activity and can plan accordingly. The project manager will schedule a meeting/conference call with the project QA supervisor, field team leader, and analytical task manager at least one (1) week prior to the sampling documented by the signatures of the personnel on the form.

### **6.2 Special Sampling Requirements**

Samples will be analyzed in the parts per billion ranges for many compounds: therefore, extreme care must be exercised to prevent sample contamination. When sampling for BTEX, field team members must use caution to ensure that the samples are not exposed to the atmosphere unnecessarily.

The following precautions should be taken when sampling for all trace contaminants:

1. Clean pair of new disposable gloves is worn for each new sampling station;
2. Sampling must be performed so that any material or liquid being collected contacting the gloves (and/or any external surface of the sample container) does not contaminate the sample;
3. When possible, samples should be collected from stations that are least contaminated (i.e. background) followed by stations in increasing of contamination; and
4. When possible, in sampling surface waters, the water sample should be collected working from downstream to upstream.

When sampling for the presence of organic parameters, the following additional precautions will be taken:

1. All sample bottles and equipment must be kept away from fuels and solvents.
2. All sampling equipment should be made of Teflon glass or stainless steel that is decontaminated. Other materials, such as plastic, may contaminate samples with phthalate esters that interfere with many analyses.
3. Water samples for volatile analysis must be collected so that no air passes through them (to prevent volatiles from being stripped from the samples); the bottles should be filled by slowly running the sample down the side of the bottle until there is convex meniscus over the neck of the bottle. The

Teflon side of the septum (in cap) should be positioned against meniscus and the cap screwed on tightly, and the sample should be inverted and bottle lightly tapped. The absence of an air bubble indicates a successful seal; if a bubble is evident, the cap should be removed, more sample added, and the bottle resealed.

4. Soil samples for volatiles analysis should be collected with as little air space as possible to prevent loss to the headspace.
5. The BTEX samples should not be composited due to the potential for loss when homogenizing the sample.

### **6.3     *Sampling Site Selection***

Soil and water sampling locations and analytical parameters were selected to document current conditions at potential contaminated areas and in adjacent locations believed to represent background conditions. These sampling sites are listed in Table 3-1 this closure sampling plan. Table 5-1 lists the environmental samples that will be collected at each site.

### **6.4     *Sample Blanks and Field Duplicates***

Two types of sample blanks must be processed: travel trip blanks and equipment (rinseate) blanks. Field duplicates and split samples are also addressed in this section.

Field duplicate samples are collected to measure the precision of the sampling process. Split field duplicate samples (sample split) will be sent to the QA laboratory.

#### **6.4.1   Trip Blank**

Trip blank are analyzed for purgeable compounds only and consist of sample bottles filled in the laboratory with organic-free water, the sample bottles are then sent to the sampling location with sample kits. The trip blanks are returned from the sampling location along with the samples designated for VOC analysis. Similarly, trip blanks will accompany split VOC samples to the QA laboratory.

#### **6.4.2   Equipment Blank**

Equipment blanks are processed by rinsing decontaminated sampling equipment with ultra-pure water obtained from the laboratory. The rinse water is collected in sample bottles, preserved, and handled in the same manner as the samples. Approximately seven (7) equipment blank samples will be collected during the program, covering the various matrices and types of sampling equipment. Collection of seven (7) equipment blanks meets the minimum five percent (5%) requirement.

#### **6.4.3   Field Duplicates**

Field duplicates will be collected during this program at the rate of one per ten samples for each sample matrix and analytical group. A minimum of one field blank will be collected per sample matrix and analytical group. The field duplicate samples will be identified on the labels and chain-of-custody forms. Split field duplicate samples will be sent to the QA laboratory.

The field duplicate samples will be identified on the labels and chain-of-custody forms as "DUP xx" (where xx represents a field assigned designation for sample identification) without further information as

to the source of the replicate. The source information will be recorded in the field notes but not on the chain-of-custody form recorded by the field team at the time of collection. The identity of the duplicates will not be given to the contractor laboratory. The source information will be forwarded to the QA reviewer to aid in the contractor's review and validation of the data. The source of the field duplicate for the QA samples will be clearly identified on the chain-of-custody form sent to the QA laboratory.

#### **6.4.4 Split Samples**

Field split samples are collected to provide a measure of comparability between laboratories. A minimum of one half that of the rate for field duplicates for collection and analyses. Split samples will be submitted to the QA laboratory.

### **6.5 *Field Equipment Decontamination***

Decontamination of sampling equipment is addressed in Section 4.3.6 of the sampling plan.

### **6.6 *Sample Containers and Preservation Techniques***

Sample volume requirements are presented in Table 5-1 along with sample container requirements for each analyte and media. The field team leader is responsible for proper sampling, labeling of samples, preservation and shipment of samples to the laboratory to meet required holding times.

Sample volume requirements are presented in Table 5-1 along with sample container requirements for each analyte and media. The field team leader is responsible for proper sampling, labeling of samples, preservation, and shipment of samples to the laboratory to meet required holding times. With hazardous samples it may be necessary to rinse the outer portion of sample containers with deionized water prior to packaging for shipment. The latest DOT and USDA procedures for shipment of environmental samples will be used in all cases. The quantity of acids or bases added as preservatives generally should not exceed 0.15 percent by weight, or the samples must be shipped as corrosives.

### **6.7 *Sample Security, Custody, Handling, Preparation and Documentation***

#### **6.7.1 Security**

Security involves procedures used to ensure sample integrity from sample collection until sample disposal after laboratory analyses are complete. Security procedures are described in the following paragraphs

Once collected, samples will be in the possession of field team members or locked in coolers in the field facility. Quality Assurance/Quality Control (QA/QC) samples will also be collected and analyzed to document sample integrity. Samples will be transported to the lab by a recognized international shipper.

Samples will be stored in the laboratory in a secure area with access limited to authorized laboratory personnel. Upon receipt of coolers containing samples, laboratory personnel will check to ensure that the chain-of-custody seals are intact, measure the temperature of each cooler and document the condition of the samples.

#### **6.7.2 Sample Custody**

The primary objective of sample custody is to create an accurate written verified record that can be used to trace the possession and handling of the samples from the moment of collection until receipt by the laboratory. Adequate sample custody will be achieved by means of approved field and analytical documentation. A sign-in and sign-out log will be maintained at the laboratory.

A sample for this project is defined to be in a person's custody if it is:

1. In one's actual physical possession;
2. In one's view after being in one's physical possession;
3. In one's physical possession and then locked or otherwise sealed so that tampering will be evident;  
or
4. Kept in a secure area restricted to authorized personnel only.

### 6.7.3 Sample Handling, Preparation, and Field Documentation

Field procedures will be designed to minimize sample handling and transfers. During sampling, field team members record the following information in field notebooks and on the field chain-of-custody log sheet using indelible ink:

1. Unique sample number as obtained from the sample label;
2. Source of sample (including site name, location, and sample type);
3. Date and time of sample collection;
4. Preservatives used;
5. Name(s) of collector(s); and
6. Field data (pH, temperature, and specific conductance) for aqueous samples.

All samples will be appropriately preserved and chilled to 4°C prior to shipment. Each sample fraction contained in the cooler will be specified on the log sheet. Other field information such as sample type, time and date of sample collection, new station code (if different from tentative station ID), and field measurements results (e.g., pH, temperature), is also entered on the log sheet. The method of shipment is entered on the log sheet and the sampler signs and dates the log sheet. The log sheet is placed in a waterproof container taped to the inside lid of the cooler, and sealed in the cooler with the samples. The custody seal will not be removed until the samples arrive in the analytical laboratory and are checked in by the analytical task manager or designee. The field team leader will alert the analytical task manager to pertinent shipping information at the end of each sampling day.

Sample container shipment will follow sample handling protocols for low, medium, and high concentration samples of hazardous waste procedures (ER-1110-1-263). The addresses of laboratories used in this project are as follows:

Primary Lab:	Laboratory Name
	Street Address
	City, State, Zip code
	Attn: Individual's Name
	Telephone Number
	Facsimile Number

Split Lab:	Laboratory Name
------------	-----------------

Street Address  
City, State, Zip code  
Attn: Individual's Name  
Telephone Number  
Facsimile Number

## **6.8 Analytical Procedures**

Analytical methods and reporting limits for the target analytes are specified in Table 5-2.

## **6.9 Internal QC Check**

Trip blanks, travel blank (trip blanks), equipment blanks (rinseate blanks), and replicate samples (duplicate samples) are discussed in Section 5.

### **6.9.1 Laboratory QC Checks**

Calibration controls will be required for analytical operations of this project. Each instrument will be calibrated and both initial and continuing calibrations will meet the minimum criteria listed in the EPA SW846 method requirements. Calibration will be documented in a parameter notebook or the analyst's notebook.

Method blanks, sample matrix spikes, surrogate spikes, QC check sample, sample duplicates, and interferant check samples will be analyzed as required by standard laboratory protocol. These analyses will be performed in accordance with SW846 protocol.

### **6.9.2 Calculation of Data Quality Indicators**

The contracted laboratory will determine if accuracy, detection limits, and completeness are within criteria set by SW 846.

## **6.10 Project Organization and Responsibilities**

An organization chart showing the project team will be developed as part of the preparation before initiation of field efforts.

### **6.10.1 Field Personnel**

The project manager is responsible for the effectiveness of day-to-day management of the project team and direct communication and liaison with AAFB. The project manager's responsibility to QA is to ensure all project QC procedures are followed during this project. The Field Team Leader is responsible for successfully accomplishing sample collection and shipment, and associated documentation.

### **6.10.2 Laboratory Personnel**

The Chemical Analysis Supervisor serves as liaison between field and laboratory operations, is responsible for the following:

1. Receipt of sample custody from field members, verification of sample integrity and transfer of sample fractions to appropriate analytical departments;

2. Coordination of sample analyses to meet project objectives;
3. Preparation of analytical reports;
4. Review of laboratory data for compliance with precision, accuracy, and completeness objectives;
5. Review of any QC deficiencies reported by the Analytical Department Manager; and
6. Coordination of any data changes resulting from review by the Project QA Supervisor and/or Project Manager.

### 6.10.3. Project QA Personnel

#### **6.10.3.1 QA/QC Personnel**

The QC staff includes both field and laboratory personnel. The Field Team Leader is responsible for all field QC procedures, and for providing consistent and accurate field data. The Field Team Leader is also responsible for implementing and overseeing all field QA/QC requirements.

The Laboratory QA/QC Officer ensures that all QC requirements for each analytical procedure or process are in place and followed.

#### **6.10.3.2 Project QA Supervisor**

The Project QA Supervisor ensures that specific QA and primary technical operations are coordinated efficiently for the project. The Project QA Supervisor is independent of the project team and is responsible for the following:

1. Performance and/or system audits of laboratory operations to ensure compliance with the QAPP;
2. System audits of field operations to ensure compliance with the QAPP;
3. Provision of guidance and coordination to rapidly resolve any QA/QC problems;
4. Independent review of QA/QC information to ensure the quality of all deliverables to, or outputs from the project team to AAFB; and
5. Interaction and communication with AAFB to resolve QA/QC problems specific to the project.

### **6.11 Calibration Procedures and Frequency**

#### 6.11.1 Analytical Laboratory Instruments

Calibration controls will be required for analytical operations of this project. Each instrument will be calibrated and both initial and continuing calibrations will meet the minimum criteria listed in the SW 846 method requirements. Calibration will be documented in a parameter notebook or, the analyst's notebook.

##### **6.11.1.1 Gas Chromatograph/High Pressure Liquid Chromatograph (GC-Non-volatiles/HPLC) Calibration**

Standard Curve Calibration -- Initial calibration standard solutions will be prepared by sequential dilution of a single stock standard solution to cover the analytical working range of the method. These may be either composite standard of more than one analyte or single-analyte solutions. The concentrations will be adjusted to take into account the instrumental and method detection limit. A minimum of three initial calibration standard concentrations or the number of standards specified by the method covering the working range and a blank will be prepared and analyzed.

The initial calibration standards and the blank will be analyzed in every analytical run. At least one calibration standard at the middle or high range of the curve will be analyzed every 20 samples and repeated at the end of the run. A QC check standard is analyzed every time new calibration standards are prepared and analyzed to verify acceptability of the new calibration standards.

The initial calibration curve will be produced by plotting the standard response for each standard versus the concentration of each standard from the initial calibration run. The concentrations of the standards may be expressed in units of mass injected or in terms of the concentration of the standard solution, if the injection volume is constant for standards and samples. QC evaluation criteria for initial calibration, recalibration, and continuing calibrations are as follows:

1. The initial calibration curve and the subsequent recalibrations possess a minimum of three points and a blank or possess the number of calibration standards specified by the method;
2. The correlation coefficient of the curve is 0.995 or greater;
3. Continuing calibration standards are within 15 percent of the same initial calibration standard for GC (25 percent for NP detector) and within 10 percent of the same initial calibration standard for HPLC;
4. The QC check standard must be within the acceptance range provided by the vendor or within 25 percent of the standard's true if a standard from a different source or lot number is used; and
5. The calibration curve brackets the response for all samples.

The concentration (or amount) of the injected sample will be obtained by entering the response for the sample into the initial calibration curve equation and determining the sample concentration after all appropriate extract and sample dilution factors have been applied.

#### **6.11.1.2 GC/MS Tuning and Calibration**

GC/MS Tuning -- Daily instrument tuning will be practiced to ensure the instrument is calibrated and in proper working condition. The GC/MS will be tuned daily with decafluorotriphenylphosphine (DFTPP) for semi-volatiles analysis and bromofluorobenzene (BFB) for volatiles analysis.

##### **6.11.1.2.1 GC/MS Calibration**

Relative response factors for the individual compounds will be determined as follows:

$$RF = \frac{A_C Q_{IS}}{A_{IS} Q_C}$$

Where:      **A** =      integrated area taken from the extracted ion current profile.  
              **Q** =      quantity of material  
              **C** =      compound and  
              **IS** =     internal standard.

Initial calibration using a minimum of five (5) levels of the compound will be used to determine the instrument linearity. The average response factor (RF) will be calculated for each compound. The response factors for the System Performance Check Compounds (SPCC) must be >0.30 (0.25 for bromoform) for EPA 8240 and >0.05 for EPA 8270. The percent relative standard deviation (% RSD) will be calculated for

each calibration check compound (CCC). The percent RSD of the (CCC) in the initial calibration must be <30 percent.

A 1-point calibration using a midlevel standard from the initial calibration will be used daily for all subsequent analysis. The RFs of the SPCC for EPA 8240 and 8270 in this continuing calibration standard must meet the minimum response factors specified for the initial calibration previously mentioned. The RFs of the calibration check compounds in this daily calibration standard should be  $\leq 25$  percent difference from the average RFs in the initial calibration.

#### ***6.11.1.3 Gas Chromatograph (GC Volatiles) Calibration***

Standard Curve Calibration -- Calibration standard solutions will be prepared as needed by sequential dilution of a single stock standard solution (prepared every 2 months) to cover the analytical working range of the method. These may be either composite standard of more than one (1) analyte or single-analyte solutions. The concentrations will be adjusted to take into account the instrumental and method detection limit. A minimum of three (3) calibration standard concentrations or the number of standards specified by the method covering the working range and a blank will be prepared and analyzed. The calibration standards and the blank will be analyzed every 20 samples and repeated at the end of the run to ensure constant instrument response. A QC check standard is analyzed every time new calibration standards are prepared to verify acceptability of the new calibration standards.

#### ***6.11.1.4 General Inorganic and Organic Parameters Calibration***

Standard Curve Calibration -- This section applies to those inorganic and organic analyses procedures [i.e., spectrophotometric, infrared (IR)] that use a standard curve for calibration. Working standard solutions will be prepared by sequential dilution of a single-stock standard to bracket the analytical working range of the method. Working standard solutions may be either composite standard of more than one (1) analyte or single-analyte solutions. The standard concentrations will be adjusted to take into account the instrument and method, upper and lower limits of linearity and the instrumental detection limit. A minimum of three (3) standard concentrations, or the number of standards specified by the method, covering the working range and a blank will be prepared and analyzed. The working standards and the blank will be analyzed at the beginning of every analytical run, and at least one (1) mid-level standard will be analyzed at minimum intervals of every 20 samples during the run and at the end of the run to check for constant instrument response.

The preparation of calibration standard is verified by the analysis of the initial calibration verification (ICV) solution. The ICV is an independent standard prepared from different stock solutions than those used to prepare the calibration standards. Typically, an EPA or NIST reference is used as the ICV and is prepared according to the supplier's instructions.

The working curve will be produced by plotting the standard response for each standard versus the concentration of each standard from the initial calibration run. The following QC evaluation criteria for working curves are:

1. The working curve possesses a minimum of three points, or the number of standards specified by the method, and a blank;
2. The correlation coefficient of the line is 0.995 or greater;
3. The response for the CCV analyzed at minimum intervals of every 20 samples during the run and at the end of the run is within 20 percent of true value;

4. The ICV is within 10 percent of the element's true value; and
5. The calibration curve brackets the response for all samples.

The sample concentration will be obtained by entering the response for the sample into the working curve equation and determining the sample concentration after all appropriate extract and sample dilution factors have been applied.

#### ***6.11.1.5 Trace Metals Analysis Calibration***

Atomic Absorption Spectroscopy (AAS) Standard Curve Calibration -- Working standard solutions will be prepared to include the analytical working range of the method; these solutions may be either composite standard of more than one metal or single-metal solution. The standard concentrations will be adjusted to take into account the instrument method, upper and lower limits of linearity and the instrument detection limit. A minimum of three (3) standard concentrations, or the number of standards specified by the method, covering the working range and a blank will be prepared and analyzed. The working standards and the blank will be analyzed at the minimum intervals of every 20 samples during the run and at the end of the run to check for constant instrument response.

The calibration is verified by the analysis of the ICV solution. The ICV is an independent standard prepared from different stock solutions than those used to prepare the calibration standards. Typically an EPA or NIST reference is used as the ICV and is prepared according to the supplier's instructions.

The working curve will be produced by plotting the standard response for each standard versus the concentration of each standard from the initial calibration run. The following QC evaluation criteria for working curves are:

1. The working curve possesses a minimum of three points or the number of standards specified by the method and a blank;
2. The correlation coefficient of the line is 0.995 or greater;
3. The response for the midlevel standard analyzed at minimum intervals of every 20 samples during the run and at the end of the run is within 20 percent of true value;
4. The ICV is within 10 percent of the element's true value; and
5. The calibration curve brackets the response for all samples.

Corrective action procedures will be taken if these QC evaluation criteria for calibration are not met.

The concentration of the sample is obtained by entering the response for the sample into the working curve equation and determining the sample concentration after all appropriate digestate and sample dilution factors have been applied.

Inductively Coupled Argon Plasma (ICAP) Single Point Calibration--This procedure uses a single standard concentration for each element to obtain an instrument response (emission counts) and is analyzed in every analytical run. A second single point emission counts obtained when aspirating a blank solution (undigested, acidified DI water), is used in conjunction with the standard to calibrate the instrument in concentration unit.

The calibration is verified by the analysis of an ICV solution which is an independent standard prepared from different stock solutions than those used to prepare the calibration standards. The elemental

concentrations of the calibration verification solution must be within the calibration range of the instrument and at concentrations other than those used for instrument calibration.

A multi-element interference check solution (ICS) and a method blank (acidified DI water that is carried through the digestion process) are analyzed each day prior to analyzing the samples. The ICS is used to verify the correction of spectroscopic interference caused by emissions adjacent to analyte emission lines.

The CCV solution is analyzed at minimum intervals of every 20 samples during the run and at the end of the run to document constant instrument response. This solution contains one-half the concentration of each element present in the calibration standards. This solution may be prepared by dilution of an aliquot of the calibration standard or prepared as a separate solution in a manner analogous to the calibration standard preparation procedure.

The following QC evaluation criteria for the instrument calibration standard are:

1. A calibration standard and a calibration blank are used;
2. All the values for the ICV are within 10 percent of each element's true value;
3. Values for the ICS are 20 percent of each element's true value; and
4. The measured concentrations of the elements in the CCV solution for which calibration was performed are within 10 percent of their respective true values.

Corrective action procedures will be taken if these QC evaluation criteria are not.

Inductively Coupled Plasma/Mass Spectrometry (ICP/MS) Single Point Calibration -- Mass calibration and tuning of the ICP/MS will be performed each time the instrument is set up. The tune response factor and mass calibration will be verified and documented before any sample analysis and at the end of each analytical run. If the mass calibration exceeds a difference of more than 0.1amu from actual value, then the mass calibration must be adjusted to the correct value.

This procedure uses a single standard concentration for each element to obtain an instrument response (intensity counts) and is analyzed in every analytical run. A second single point intensity counts obtained when aspirating a blank solution (undigested, acidified DI water) is used in conjunction with the standard to calibrate the instrument in concentration limits.

The calibration is verified by the analysis of an ICV solution which is an independent standard prepared from different stock solution than those used to prepare the calibration standards. The elemental concentration of the calibration verification solution must be within the linear range of the instrument and at concentrations other than those used for instrument calibration.

A multi-element interference check solution (ICS) and a method blank (acidified DI water that is carried through the digestion process) are analyzed each day prior to analyzing the samples. The ICS is used to verify the adequate application of elemental interference equation.

The CCV solution is analyzed at minimum intervals of every 10 samples during the run and at the end of the run to document constant instrument response. This solution contains one-half the concentration of each element present in the calibration standards. This solution may be prepared by the dilution of an aliquot of the calibration standard or prepared as a separate solution in a manner analogous to the calibration standard preparation procedure.

QC evaluation criteria for the instrument calibration standard are as follows:

1. A calibration standard and a blank are used;
2. All the values for the ICV are within 10 percent of each element's true value;
3. Values for the ICS are adequately corrected for in the interference equation; and
4. The measured concentrations of the elements in the CCV solution for which the calibration was performed are within 10 percent of their respective true values.

Corrective action procedures will be taken if these evaluation criteria are not met.

#### **6.11.1.6 Gravimetric Methods Calibration**

Two general types of analytical balances are used at most commercial laboratories:

1. The more sensitive microanalytical balance, and
2. The top-loading balance.

The calibration of the microanalytical balances is verified daily by weighing the following Class S and NIST-certified weights [in grams (g)]:

Weight (g)	Tolerance Limits
0.2	+0.0005
1.0	+0.0005
3.0	+0.0005
5.0	+0.0005

The calibration of the top loading balance is verified daily by weighing the following Class S and NIST – certified weights:

Weight (g)	Tolerance Limits
5	+0.02
20	+0.05
50	+0.05

The results are recorded in the instrument logbook. If these criteria are not met, the weight may be reweighed. If the criteria are not met for the second weighing, the balance is taken out of service and repaired. The Class S weights are sent to the manufacturer yearly for calibration and recertification. Two sets of Class S weights are available in-house.

### **6.12 Data Reduction, Validation, Reporting**

#### **6.12.1 Field Data**

All field information will be recorded in sequentially numbered bound notebook using non-erasable, waterproof ink. The Field Team Leader is responsible for initial data validation including and ensuring the following:

1. Completeness of field records, and

2. QC measures for sampling procedures (i.e., duplicates, trip blanks, equipment blanks, and calibration checks).

Field analytical data (i.e., pH, temperature, and conductivity) will be sent to the contracted laboratory on the chain-of-custody field log sheet and will be included with the project analytical deliverable as a hard copy laboratory report.

Data transfer and reduction are essential functions in summarizing information to support conclusions. It is essential that these processes are performed accurately and in the case of data reduction, that accepted statistical techniques are used. QA/QC procedures will be adhered to as outlined in this QAPP.

Example calculations will be included with the analytical method where appropriate, to facilitate review. The entry of input data and calculations should be checked and the signature/initials of the data technician and reviewer(s) should accompany all data transfers with and without reduction.

For routine analyses performed at the laboratory, sample response data information will be entered into the computer system by the Laboratory Analyst or other designated individual(s). The computer calculates the following:

1. Linear or quadratic regression line for standards;
2. Coefficients of variation for replicates;
3. Spiked recoveries;
4. Reference sample concentrations, and
5. Sample concentrations.

Linear or quadratic equations will be used to calculate final data for laboratory analyses requiring a calibration curve:

$$\text{Concentration} = \text{Intercept} + M (\text{Response}) + M2 (\text{Response})^2$$

The equation used to calculate the final data for laboratory is independent on the linearity of the standard curve and method of analyses.

Purgeable organics by GC/MS are calculated as follows:

$$\text{Concentration (ug/L)} = \frac{(A_{sa})(Q_{is})}{(RF)(A_{is})(PV)}$$

Where:

- $A_{sa}$  = area from the extracted ion profile of the primary characteristic ion for the target analyte in the sample
- $Q_{is}$  = quantity of the internal standard [nanograms (ng)]
- $RF$  = Response factor (see Section 5.12.1.1),
- $A_{is}$  = area from the extracted ion profile of the primary characteristic ion of the internal standard in the sample, and
- $PV$  = purge volume (milliliter (mL))

Acid and base/neutral extractable are calculated as follows:

$$\text{Concentration (ug/L)} = \frac{(A_{sa}) (Q_{is})}{(A_{is})(RF)} * \frac{1}{FE} * \frac{1}{\text{volume}} * DF$$

$A_{sa}$  = area from the extracted ion profile of the primary characteristic ion for the target analyte in the sample

$A_{is}$  = area from extracted ion profile of the primary characteristic ion of the internal standard in the sample

$Q_{is}$  = quantity of the internal standard (ng)

$RF$  = response factor (see Section 5.12.1)

$FE$  = fraction extract analyzed

*Volume injected [microliter(ug/L)]*

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*Extract volume (uL)*

**Volume** = volume of extracted sample (mL), and

**DF** = dilution factor

*Final extraction volume for injection (mL)*

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*Extraction volume prior to dilution (mL)*

QC acceptance criteria for the relative percent difference of replicate spike recoveries and for the range of acceptance recoveries will be stored in the data management computer files for each STORET number/method code combination. If the sample in a sample lot does not pass the entire QC checks the results reported in all samples processed in the same sample set may be considered suspect and the analysis may need to be repeated.

Completed batch folders will be stored in a central location arranged by department and numerically by batch number. Raw instrument output copies of parameter notebook, pertinent calculations, and solution documentation will be stored in the batch folders.

When the data set is complete for each sampling effort, the computer will be used to organize the information in the field group in numerous formats. The final reports will be reviewed and approved by the Laboratory Coordinator.

## 6.12.2 Sampling and data Results Report

### 6.12.2.1 Report Format

Laboratory data reports will be generated directly without manual manipulation. The analytical report will include the following items:

1. Case narrative will include a general discussion of the results and any analytical problems encountered;
2. Laboratory data, all field QC sample results (including trip blanks, equipment rinseate, and field duplicates) and tentatively identified compound (TIC) reports for semi-volatiles;
3. Dates of collection, extraction, and analysis, and the days elapsed between each step of the analytical process;

4. Methodology and batch number for each sample; and
5. Sample ID cross reference (to field and laboratory ID).

The laboratory data will be provided in hard copy. Copies of completed chain-of-custody forms will also be provided. These forms will include the temperature of the cooler upon arrival and the general conditions of the samples.

### **6.13 Performance and System Audit**

Two (2) types of audit procedures will be used to assess and document the performance of the project staff: system audit and performance audits. These are performed at frequent intervals under the direction of the Project QA Supervisor. These audits form one of the bases for corrective action requirements and constitute a permanent record of the conformance of measurement systems to QA requirements.

#### **6.13.1 System Audit**

System audits are inspections of training status, records, QC data, calibrations, and conformance to SOPs without the analysis of check samples. System audits are conducted quarterly for the laboratory. Field audits may be conducted at the initial sampling activities of this project.

The system audit protocol is summarized as follows:

1. Field Operations – The Project QA Supervisor will periodically:
  - (a) Check field notebooks, log sheets, chain-of-custody forms, and report any inconsistencies and/or omissions; and
  - (b) Check implementation of field sampling procedures: calibration of field instruments, decontamination, packaging, and shipping.
2. Laboratory Operations – The Project QA Supervisor will periodically check:
  - (a) Parameter and/or laboratory notebook;
  - (b) Instrument logbook;
  - (c) Sample log-in, dispensing, and labeling for analysis;
  - (d) Update QC criteria for spike recoveries; and
3. Final Reports – The Project QA Supervisor will audit the deliverable review sheets to ensure that all final report are peer reviewed before they are sent to the client.

#### **6.13.2 Performance Audit**

The contracted laboratory should participate in the following proficiency programs:

1. National Institute of Occupational Safety and Health (NIOSH) through its Proficiency Analytical Testing Program (PAT) and Environmental Lead Proficiency Analytical Testing Program (ELPAT);
2. EPA Water Pollution and Water Proficiency Programs;
3. USACE; and
4. Department of Energy Environmental Measurement Laboratory Quality Assessment Program.

### **6.14 Preventive Maintenance**

To minimize the occurrence of instrument failure and other system malfunctions, a preventive maintenance program for field and laboratory instruments is being implemented. The preventive maintenance performed for each major piece of field and analytical equipment is listed in the following sections.

All maintenance performed on the laboratory instruments are documented in each instrument's maintenance logbook which is kept with the instrument. The date, initials of the analyst performing the maintenance, and the type of maintenance performed are recorded in this maintenance logbook. Receipts from the routine maintenance performed by the manufacturer's representative are kept on file.

### **6.15 Corrective Actions**

Corrective action is necessary when any measurement system fails to follow this QAPP. Item which may need corrective action range from a minor problem of a field team member failing to sign a field form to a major problem of a Laboratory Analyst using an improper analytical method. For this reason, corrective action protocol must be flexible. In general, items needing corrective action fall into three (3) correction categories: Short term, long term, and QC; each requires different action.

#### **6.15.1 Short-Term Corrective Action**

Short-term problems may be minor and major problems, which can be corrected immediately. Examples include failure to date or sign a field form, incorrectly preserving samples, and errors in data entry. Corrective action is initiated by verbally calling attention to the problem and seeing that it is corrected.

#### **6.15.2 Long-Term Corrective Action**

Long-term problem may be minor and major problems, which require series of actions to resolve. The actions to be taken are coordinated by the Project QA Supervisor, and a QA corrective action request and routing form is used to track the action. An example of this type of corrective action is as follows:

Problem – A field team member fails to calibrate the pH meter in the field prior to use.

Corrective Action – The problem is identified by the person originating the corrective action, responsibility is assigned to an appropriate person (may be someone other than the person failing to calibrate the meter) an appropriate standard is selected, the standard is ordered, the order is verified as being filled properly, field members are trained in the use of the standard as required, and the pH meter is calibrated in the field during the next field trip. The Project QA Supervisor audits this process to ensure that it is completed in an expeditious manner.

#### **6.15.3 QC Corrective Action**

These actions consist of corrective action following a failure to meet QC criteria specified in this QAPP and the analytical methods. Action taken consists of two (2) types:

1. Those resolved within each analytical department; and
2. Those resolved outside the department.

Examples outlining the difference between these two (2) types of corrective actions are as follows:

#### **WITHIN-DEPARTMENT ACTION:**

### QC Failure

### Department Action

Tuning results for GC/MS  
fail criteria in EPA  
Method 8240 and 8270

Laboratory Analyst retunes instrument

Percent recoveries fail  
Criteria and sample  
holding time have not  
expired

Laboratory Analyst investigates problem  
and re-analyses

Standard curve correlation  
coefficient is less than  
0.995

Laboratory Analyst investigates problem  
and re-runs curve and samples

Sample response falls  
outside calibration curve

Laboratory Analyst dilutes sample into  
range of curve

### **OUTSIDE-DEPARTMENT ACTION:**

### QC Failure

### Department Action

Holding time are exceeded

Notify Project Manager and Project QA  
Supervisor re-sampling may be necessary

Percent recoveries fail  
criteria and sample  
holding time have  
expired

Notify Project Manager and QA  
officer, re-sampling may be  
necessary if a significant number  
of QC failures occur

Corrective action may be initiated for each measurement system (individual disciplines) by the Project Manager or other responsible individuals such as the laboratory QA/QC Manager. The Project QA Supervisor and the Project Manager will be responsible for approving the corrective action. AAFB will be notified in writing within 48 hours of any significant QA/QC problem.

### **6.16 QA Reports to Management**

Activities and actions to be reported will include:

1. The project status in relation to the progress of proposed schedule
2. Result of ongoing system audits, and
3. Proposed corrective action and significant QA problems.

The Project QA Supervisor reports the results of these activities to the Project Manager and the affected line managers.